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Railway Mechanical Engineer

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August - 1934

Progressive Spot System On the Lehigh Valley

IN an effort to meet the ever-increasing demand for improved service and higher operating speeds the mechanical department of the Lehigh Valley found it necessary to assure a higher quality of workmanship in locomotive repairs and a more thorough inspection of locomotive parts during the progress of the work in the shop. During the past few years practically all of the major heavy locomotive repair work on that system has gradually been concentrated at the system's shops at Sayre, Pa. The Sayre shop is of the transverse type, having erecting bays on both sides of the shop and light and heavy machine bays in between. The shop is served by an outside turntable at the main entrance rather than by a transfer table.

In spite of the fact that the facilities at Sayre have been continually improved and progress has been made over a period of years in the method of operating the shop, it was found, after a thorough study was made of the demands on the shop under present conditions, that the desired objectives in locomotive repair work could not be reached under the conventional system of operating this type of shop; namely, that of spotting locomotives on erecting pits and performing all of the work from stripping to reassembling in the one position. This

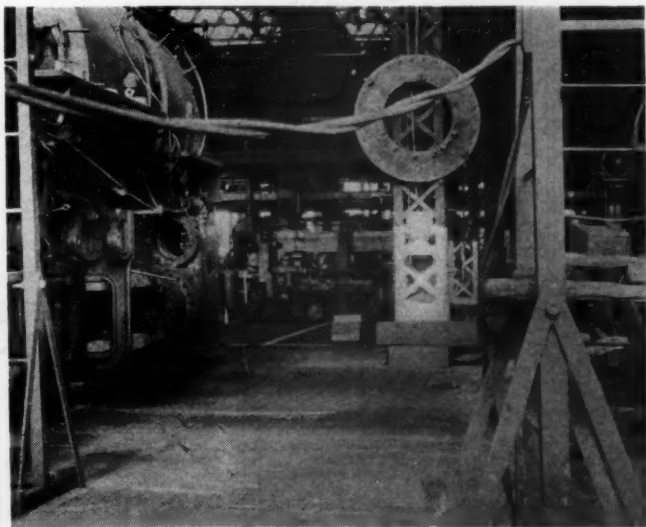
The application of the progressive system in the Sayre, Pa., locomotive shop is one of the first efforts to apply modern straight-line methods to the transverse type of shop

system made it necessary particularly to store parts adjacent to locomotives undergoing repairs in such a manner as to result in considerable congestion in the erecting shop, plus the fact that it required the transportation of locomotive parts to be repaired or to be applied over long distances to and from the several departments in the shop.

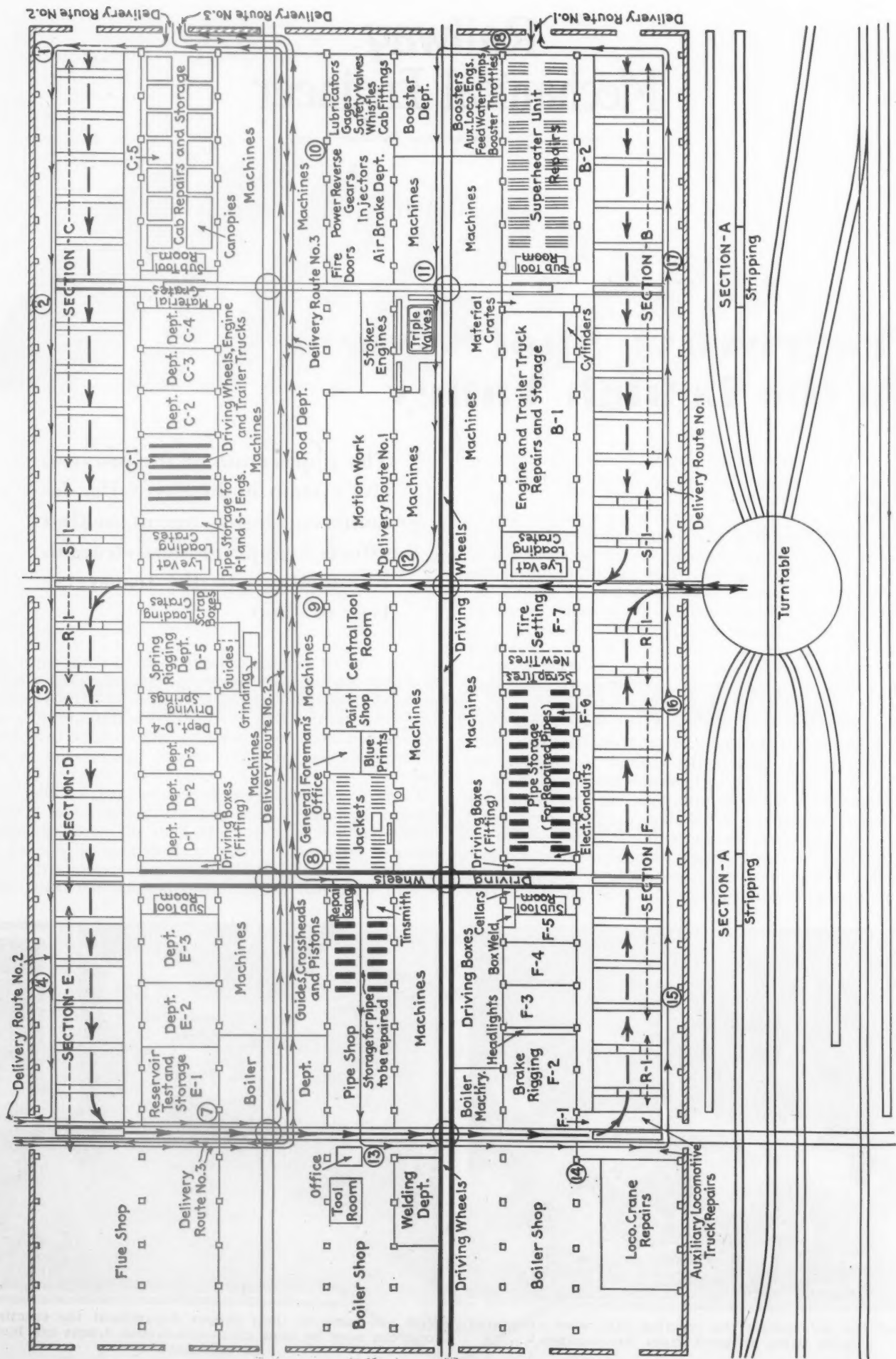
To meet present-day conditions the Lehigh Valley mechanical department developed a progressive spot system of locomotive repairs which is, after all, merely an adaptation of progressive repair methods applied to a transverse type of shop. While up to quite recently the volume of work handled at Sayre shop has not been suffi-



Under the old system the erecting pits were congested with parts stripped from locomotives



With the parts in their proper department the erecting floor can now be kept clear—Smokebox fronts are hung on columns



Layout of the Sayre locomotive shop showing various sections and material delivery routes

cient to permit conclusions to be drawn as to the ultimate advantages of this progressive system, it is true that during the past year that it has been in operation there are many indications that the new method of handling the work of repairing locomotives has resulted in sufficient advantage to justify the change that has been made. The changes that were necessary in the shop incident to the actual installation of the progressive system extended over a period of about seven months.

Generally speaking, the principal difference between the progressive spot system of repairing locomotives in

so far as physically possible, each department and facility has been located at the shortest possible distance from the point in the shop where the repaired parts are reapplied to the locomotive as it passes through the shop in the process of repair and assembly. One of the handicaps of the former system was that there was possible no systematic method of storing locomotive parts while awaiting repair or after having been repaired, plus the fact that the storage locations then available were not only in locations where, in many cases, it was highly undesirable to have stored parts, but they were also of inadequate capacity.

This applied particularly to such classes of material as jackets and piping. The old jacket storage, for example, had only nineteen sections, which was entirely inadequate, whereas the new storage location is equipped with

Table I—Work Handled in Major Sections

Section	Operation	Work Performed
A	Stripping	Locomotive completely stripped outside of shop excepting removal of driving wheels, engine and trailer trucks.
B	Heavy boiler work	Fireboxes, flues, throat, flue and side sheets, boiler courses, cylinder work, cylinder and valve-chamber bushings, frame work, frame braces, deck castings, pedestal binders, waist sheets, furnace and deck sheets, layout shoes and wedges, guide yokes, apply throttle, steam and dry pipes, auxiliary dome, arch tubes, smokebox, fronts, stacks, cinder pockets, dome covers, guide yoke and knees, sand box, superheater header.
C	Light boiler work	Flues, units, patches, stay and crown bolts, caps, cylinder work, cylinder and valve-chamber bushings, frame work, frame braces, deck castings, pedestal binders, waist sheets, furnace and deck sheets, layout shoes and wedges, guide yokes, apply throttle, steam and dry pipes, auxiliary dome, arch tubes, smokebox fronts, stacks, cinder pockets, dome covers, guide yoke and knees, sand box, superheater header.
D	Boiler testing	Apply pressure fittings—test boiler—apply jacket, lagging, cab, canopy, dome casings, blowout cylinders and steam passages, apply air reservoirs, air-pump brackets, ash pans, boiler mountings, buffers, couplers, drawbars, fire-doors, flagstaffs, grate bearers, grate-shaker, fulcrums, cylinder jacket, power reverse bracket, reverse-shaft counterbalance, reverse-shaft, running boards, throttle and reverse levers, boiler checks, safety valves, steam turret, steam-pipe casings, springs, equalizers and saddles, shoes and wedges, stoker and conveyor, valve-gear frame, water columns, whistle, brake cylinders, deck boards—sheets, blow-off cock, miscellaneous small brackets.
E	Assembling	Wheel engine—apply pistons, valves, guides, crossheads, rods, motion work, air pumps, auxiliary locomotive and booster throttles, booster pipes, blower connections, bumper beams, cylinder heads and casings, cutting lever, damper valves, exhaust stand and nozzle, feedwater heater and pump, mechanical lubricator, pedestal binders, pilot and steps, power reverse gear, smoke-box braces, fire-door shields—grate lever locks—shields, hand railing and safety appliances, smoke-box door, steam chest cover and casings, valve chamber heads and casings, air-brake appliances.
F	Finishing	Cab work, train control, electrical work, set valves, all pipe work, apply apron, bell, brake rigging, brick arch, cab fittings, cylinder cocks and rigging, draft appliances, drifting valve, flue blower, generator, grates, headlight, injectors, tank air, sanders, stack extensions, water glasses, test air, painting and general finishing up of engine.

this shop and the conventional system formerly in use is that, whereas materials and workmen went to the locomotive which was in a fixed location, the locomotive now moves from one specialized location to another and the re-arrangement of departments, and to a certain extent facilities, has been such that under the present system, in

Table II—Movement of Parts in the Shop

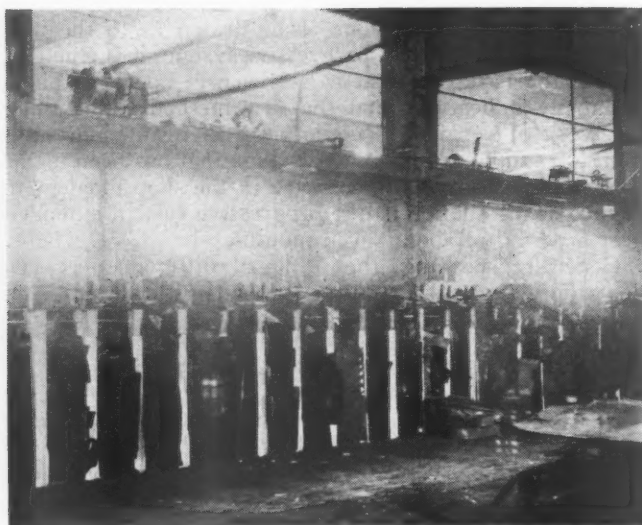
Locomotive part	Delivered to department or section	Repaired in department or section	Stored in department or section	Applied in department or section
Air-brake appliances.....	Air brake	Air brake	Air brake	E
Air pumps.....	Air brake	Air brake	D-4	E
Air-pump bracket.....	D-1	D-1	D-1	D
Air reservoirs.....	Lye vat	E-1	E-1	D
Apron.....	F-4	F-4	F-4	F
Arch tubes.....	Pipe	Pipe	Pipe	B and C
Ash pans.....	Boiler	Boiler	Boiler	D
Ash-pan supports.....	Boiler	Boiler	D-1	D
Auxiliary dome.....	C-3	C-3	C-3	B and C
Aux. loco truck.....	F-1	F-1	F-1	Tank
Aux. loco. engine.....	Lye vat	Booster	Booster	F-1
Aux. loco. throttle.....	Booster	Booster	Booster	E
Bells.....	Lye vat	F-3	F-3	F
Bell stand.....	Lye vat	F-3	F-3	F-3
Bell ringers.....	Air brake	Air brake	F-3	F-3
Blow-off cock.....	Air brake	Air brake	Air brake	D
Booster engine.....	Lye vat	Booster	B-1	B-1
Booster throttle.....	Booster	Booster	Booster	E
Booster pipes.....	E-3	E-3	E-3	E
Boiler check.....	Air brake	Air brake	Air brake	D
Brake cylinders.....	C-4	C-4	C-4	D
Brake rigging.....	Lye vat	F-2	F-2	F
Buffers.....	E-2	E-2	E-2	D
Bumper beams.....	E-2	E-2	E-2	E
Blower connections.....	Air brake	Air brake	Air brake	E
Cab.....	C-5	C-5	C-5	D
Cab fittings.....	Air brake	Air brake	Air brake	F
Cellars.....	Lye vat	Box	Box	Box
Center Pins.....	B-1	B-1	B-1	E
Cinder po-kets.....	C-4	C-4	C-4	B and C
Couplers.....	E-3	E-3	E-3	D
Coupler pocket.....	E-3	E-3	E-3	D
Crossheads.....	Lye vat	Piston	Piston	E
Crosshead pins.....	Lye vat	Piston	Piston	E
Cutting Lever.....	E-2	E-2	E-2	E
Cylinders.....	C-4 and B-1	C-4 and B-1	C-4 and B-1	B and C
Cyl. heads—front.....	E-3	E-3	E-3	E
Cyl. heads—back.....	Lye vat	E-3	E-3	E
Cyl. head casings.....	E-3	E-3	E-3	E
Cylinder cocks.....	Air brake	Air brake	Air brake	F
Cyl. cock rigging.....	Lye vat	D-1	D-1	F
Canopy.....	C-5	Boiler	C-5	D
Cylinder jacket.....	Boiler	Boiler	Boiler	D
Damper valves.....	Air brake	Air brake	Air brake	E
Deck—Center castings.....	C-4	C-4	C-4	B and C
Deck sheet—Boards.....	Boiler	Boiler	D-1	D
Dome covers.....	C-3	C-3	C-3	B and C
Dome casing.....	E-2	E-2	E-2	D
Draft appliances.....	F-4	F-4	F-4	F
Drawbars.....	C-4	C-4	C-4	D
Drifting valve.....	Air brake	Air brake	Air brake	F
Driving wheels.....	C-1	Wheel	Wheel	E
Driving springs.....	Lye vat	D-5	D-5	D
Driving boxes.....	Lye vat	Box	Box	Wheel
Dry pipe.....	C-3	C-3	C-3	B and C
Eccentric cranks.....	Lye vat	Motion work	Motion work	E
Engine Truck.....	Lye vat	B-1	B-1 and C-1	E
Equalizers.....	Lye vat	D-5	D-5	D
Exhaust stand.....	E-3	E-3	E-3	E
Exhaust nozzle.....	E-3	E-3	E-3	E
Electrical Conduit.....	F-6	F-6	F-6	F
Feed water heater.....	Booster	Booster	Booster	E
Feed water pump.....	Booster	Booster	Booster	E
Fire Brick.....	F-5	None	F-5	F
Fire door.....	Air brake	Air brake	D-2	D
Fire door frame.....	Air brake	Air brake	D-2	D
Flagstaff.....	D-1	D-1	D-1	D
Flues.....	Flue	Flue	B-2	B and C
Flue blowers.....	Air brake	Air brake	Air brake	F
Flue Bl. Op. levers.....	E-2	E-2	E-2	F
Frames.....	C-4	C-4	C-4	B and C
Frame braces.....	C-4	C-4	C-4	B and C
Frame crossies.....	C-4	C-4	C-4	B and C
Furnace sheets.....	Boiler	Boiler	Boiler	B and C
Fire door shields.....	D-1	D-1	D-1	E
Gage.....	Air brake	Air brake	Air brake	F

Reference Key to Departments Not Otherwise Identified in the Layout on the Opposite Page

Dept. or section	Parts or Work Handled
C-2	Shoes and wedges and binders.
C-3	Steam pipes, throttle, dome and turrets.
C-4	Brake cylinders, frame braces, deck and center castings, guide yokes, drawbars, cylinders.
D-1	Miscellaneous small brackets, deck boards and sheets, firedoor shields, shaker locks and guards.
D-2	Stoker department—Firedoors, shaker castings.
D-3	Special tools and appliances.
D-4	Stacks, smokebox doors, sand boxes.
E-2	Hand rails, safety appliances, pilots, steps, smokebox braces, running boards, dome castings, flue blowers, operating levers.
E-3	Steam-pipe casings, valve-chamber heads and casings, cylinder-head casings, valve-gear frame, exhaust pipes and nozzles, couplers, coupler pockets, steam-chest covers and casings.
F-1	Auxiliary locomotive truck repairs.
F-3	Headlight generators, train control, bells.
F-4	Draft appliances, stack extensions.
F-5	Grates, fire brick and grate rods.



The old jacket storage was inadequate for the shop and many jacket parts had to remain on the floor



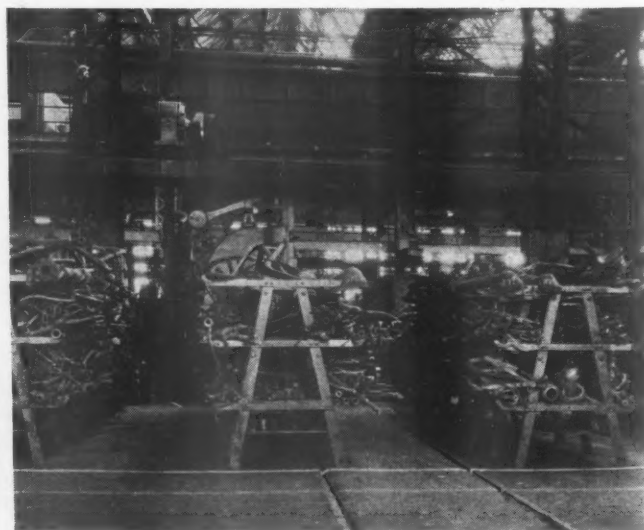
The new jacket storage has 49 sections, sufficient to care for all of the locomotives undergoing repair

Table II (Continued)

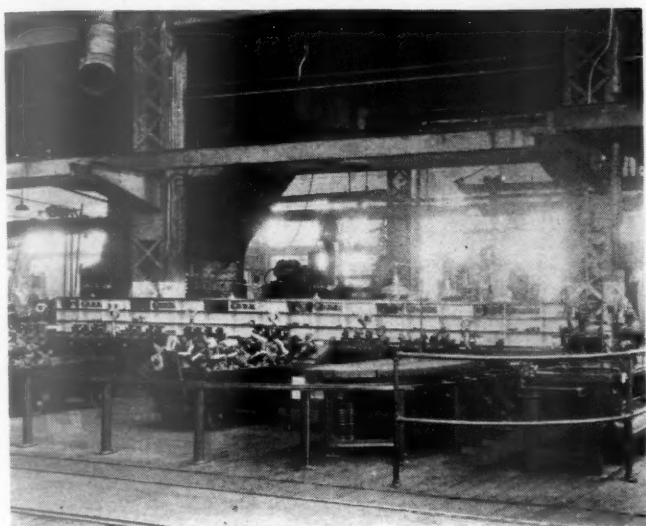
Locomotive part	Delivered to department or section	Repaired in department or section	Stored in department or section	Applied in department or section
Gage lamp.....	Electrical	Electrical	Electrical	F
Gage cocks.....	Air brake	Air brake	Air brake	F
Generator.....	Electrical	Electrical	F-3	F
Grates.....	F-5	F-5	F-5	F
Grate bearers.....	D-1	D-1	D-1	D
Grate levers.....	D-2	D-2	D-2	D
Grate Lev. fulcrum.....	D-2	D-2	D-2	D
Grate rod.....	F-5	F-5	F-5	F
Guides.....	Lye vat	Piston	Piston	E
Guide yokes.....	C-4	C-4	C-4	B and C
Guide yoke knees.....	C-4	C-4	C-4	B and C
Gr. Lev. Locks—Guards.....	D-1	D-1	D-1	E
Hand Railings.....	E-2	E-2	E-2	E
Headlight.....	F-3	Jacket	F-3	F
Hub Liners.....	Wheel	Wheel	Wheel	Wheel
Injectors.....	Lye vat	Air brake	Air brake	F
Injector levers.....	Air brake	Air brake	Air brake	F
Jackets.....	Jacket	Jacket	Jacket	D
Lagging.....	Lagging	Lagging	Lagging	D
Lubricator.....	Air brake	Air brake	Air brake	E
Marker lamps.....	Electrical	Electrical	Electrical	F
Motion work parts.....	Lye vat	Motion work	Motion work	E
Pedestal binders.....	Lye vat	C-3	C-2	E
Pilot.....	E-2	E-2	E-2	E
Piping.....	Pipe	Pipe	F-6	F
Pistons.....	Piston	Piston	Piston	E
Piston rod packing.....	Piston	Piston	Piston	E
Power reverse gear.....	Air brake	Air brake	Air brake	E
Power rev. bracket.....	D-1	D-1	D-1	D
Reach rod.....	Motion work	Motion work	Motion work	E
Reverse levers.....	Motion work	Motion work	Motion work	D
Reverse shaft.....	Lye vat	C-4	C-4	D
Rev. counterbalance.....	D-1	C-4	C-4	D
Rods.....	Lye vat	Rod	Rod	E
Running boards.....	E-2	E-2	E-2	D
Small Brackets (Misc.).....	D-1	D-1	D-1	D
Safety valves.....	Air brake	Air brake	Air brake	D
Safety appliances.....	E-2	E-2	E-2	E
Sand boxes.....	D-4	D-4	D-4	B and C
Sand traps.....	Air brake	Air brake	D-4	F
Sander valves.....	Air brake	Air brake	Air brake	F
Shoes and wedges.....	Lye vat	C-2	C-2	E
Smokebox braces.....	E-2	E-2	E-2	D
Spring hangers.....	Lye vat	D-5	D-5	D
Spring Saddles.....	Lye vat	D-5	D-5	D
Spring seats.....	Lye vat	D-5	D-5	D
Stack.....	D-4	D-4	D-4	B and C
Stack extension.....	F-4	F-4	F-4	F
Steam pipes.....	C-3	C-3	C-3	B and C
Steam pipe casings.....	E-3	E-3	E-3	D
Steam turret.....	Air brake	Air brake	C-3	D
Steps.....	E-2	E-2	E-2	E
Stoker Engine.....	Lye vat	Motion work	D-2	D
Stoker conveyor.....	Lye vat	D-2	D-2	D
Stoker distributor.....	Pipe	Pipe	Pipe	D
Superheater flues.....	Flue	Flue	B-2	B and C
Superheater header.....	C-3	C-3	C-3	B and C
Superheater units.....	B-2	B-2	B-2	B and C
Smokebox front.....	B and C	B and C	B and C	B and C

Locomotive part	Delivered to department or section	Repaired in department or section	Stored in department or section	Applied in department or section
Smokebox Door.....	D-4	D-4	D-4	E
St. chest covers—Casings.....	E-3	E-3	E-3	E
Throttle valve.....	C-3	C-3	C-3	B and C
Throttle lever.....	Motion work	Motion work	Motion work	D
Trailer Truck.....	B-1	B-1 and C-1	B-1	E
Train control parts.....	Electrical	Electrical	F-3	F
Tires.....	Machine	Machine	F-7	F-7
Valves.....	Motion work	Motion work	Motion work	E
Valve gear frame.....	E-3	E-3	E-3	D
Val. Chamb. Hds.—Casings.....	E-3	E-3	E-3	E
Waist sheets.....	C-4	C-4	C-4	B and C
Water glasses.....	Air brake	Air brake	Air brake	F
Water column.....	Air brake	Air brake	Air brake	D
Whistle.....	Air brake	Air brake	Air brake	D
Whistle levers.....	Air brake	Air brake	Air brake	D

forty-nine sections, which is entirely sufficient to accommodate in each section the complete jacket for each locomotive in the shop undergoing repairs. Similar conditions existed in connection with the storage of locomotive piping. Whereas under the old system piping was stored in some twenty-two locations about the shop, under the new system all of the piping is on racks so de-



Piping which, under the old system, was usually left at some point near the pit, is now repaired and placed in racks



The triple-valve repair department, also on a progressive system, handles the repairs for the entire system



Another view of the triple-valve repair department showing the work bench and many of the special tools

signed that the piping from each individual locomotive in the shop is on a portion of the rack by itself. It is not only possible to see at a glance the condition of the piping, but the systematic method of storing it also lends itself to a more efficient method of repairing piping and, in addition, assures that very little of the piping from a locomotive is ever lost.

Mention is made of the method of storing jackets and piping merely because it is typical of the manner in which the storage of materials and parts all through the shop has been carried out. It will be noticed from the full-page shop layout accompanying this article that these storage locations and departments have been located in such a manner as to facilitate in every way possible the maximum efficiency in repair work.

Movement of Locomotives and Parts

All work pertaining to locomotive repairs in the Sayre shop is now done under one main roof, with the exception of repairs to generators and electrical equipment which are handled in a specialized shop. In conjunction with the installation of the progressive spot system, a materials and parts delivery system was developed to meet the new conditions. By reference to the general layout



Draft appliances, headlights, generators and bells are repaired and stored in special racks in this section

of the shop and the information given in Tables I and II, it will be possible for the reader to follow with very little difficulty the movement of a locomotive through the shop and to trace the movement of any individual locomotive part as it passes through the shop for repairs and re-application.

All locomotives at Sayre are stripped outside the shop on the tracks marked "Section A." The stripping is complete, with the exception of the removal of the driving wheels and engine and trailer trucks. The engine is then run over the turntable and moved inside the shop. Here the locomotive is placed in either Section B or C. Into which of these two sections the locomotive goes depends entirely at this stage of the operation upon the amount of boiler work to be done. Locomotives requiring a comparatively light amount of boiler work are placed in Section C and from there continue in their progressive course around the shop.

Locomotives which require a large amount of boiler work, such as new fireboxes or an unusual number of sheets, if placed in Section C at the outset would merely hold up the progressive movement to successive sections. These locomotives are, therefore, placed in Section B and all locomotives in this section have no particular schedule in relation to the shop as a whole, but the heavy boiler work is performed here and when it has progressed to a state where the locomotive can be placed in the progressive line without holding up the scheduled movement, it is then taken out of Section B and placed in Section C. Other than the boiler work, the work on parts to be repaired in Sections B and C can be seen by reference to Table I.

After the necessary work on locomotives in Section C has been completed, the locomotive is picked up with the overhead crane and moved to Section D. Incidentally, practically all of the movements of the locomotive from one section to the other are made at night so as not to interfere with the normal operations on the day shift. The principal work performed in this section is shown again by reference to Table I.

Section D has been especially equipped for the work of boiler testing and each pit in this section has been fitted with a complete layout of steam and water lines, making it unnecessary to use long hose lines for the testing of boilers.

Upon completion of the work in Section D the locomotive is then moved over into Section E where the

work of reassembling finally begins. The wheeling of a locomotive, for example, is done in Section E. One pit in this section has been especially equipped with blocks and binder jacks which make it possible for a minimum number of workmen to wheel a locomotive with the least possible loss of time. Incidentally, many locomotive operations, such as wheeling, which would ordinarily interfere with workmen on the first shift, are performed on the second trick. Pistons, valves, guides, crossheads, rods and motion work are applied in this section.

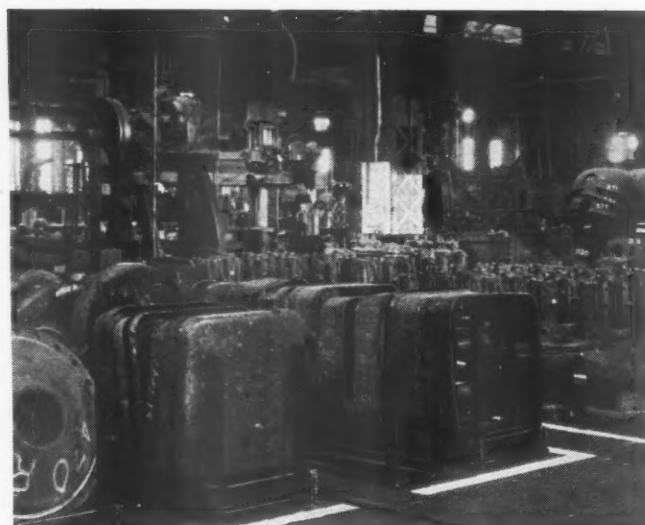
After the locomotive leaves the assembling Section E, it is moved across the shop, turned and lifted over into Section F where the final finishing work is performed. Here such work as the application of cab fittings, train control, electrical work, all pipe work, valve setting and painting, is done. Here also the shop testing is performed and, after this is completed, the locomotive is ready to leave the shop for final testing under steam.

It will be noticed, by reference to the shop layout, that eight pits adjacent to the central shop track and two pits adjacent to Section F near the brake-rigging department are set aside for R-1 and S-1 class locomotives. It so happens that these Lehigh Valley locomotives are of such length that they cannot readily be moved to other sections of the shop.

Departmental Operations

Many of the sub-departments of the shop were completely rearranged and, in many cases, re-equipped coincident with the installation of the progressive spot system. For example, a complete triple-valve department was installed which now does the repair work on all of the triple valves for the Lehigh Valley system. The idea of the progressive system has been carried out in this department on a small scale and it can be seen from the illustrations of this department that the triple valves are moved progressively around a runway on small cars operating on a circular track. They are delivered to this department in special containers by the shop delivery system. They go first to the stripping machines, after which the parts are cleaned and gaged and are then placed in small cars accommodating four valves.

These cars proceed to the repair bench where many special tools have been developed to facilitate the handling and repair of the valves. After the valves are assembled, they are placed by the workmen in the small cars and passed to the test rack. Valves that pass inspection

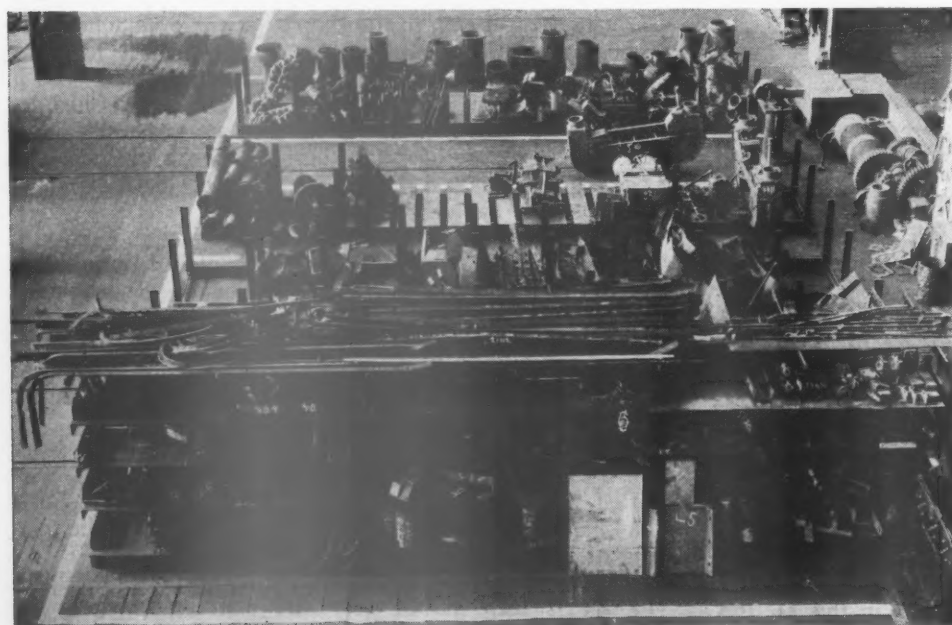


Cylinder heads and casings, steam-chest covers and valve-chamber-head casings have racks for storage

are placed immediately on a bench in a special container in which they are removed for packing preparatory to shipment. Any valves which do not pass inspection are immediately replaced in one of the small cars on the circular track and go round again to the man who originally assembled them.

One of the most noticeable improvements in the shop was made in the brake-rigging department where considerable difficulty was experienced under the old system in keeping the work up to date. Under the new method the brake rigging after having been removed from the locomotive and cleaned is taken directly to the blacksmith shop, from which it is delivered to the machine shop for necessary repairs. It is then taken to the brake-rigging department and placed in storage racks and classified. In assembling brake rigging it is placed on a movable platform which, when loaded, is moved to the locomotive in the finishing section by overhead crane.

Under the old system of repairing a locomotive many small brackets when removed from locomotives were either destroyed or lost. This not only caused considerable expense, but it was found that the location of the appliances which were secured by the brackets usually



Miscellaneous brackets are carefully stored to prevent loss



The spring-rigging department showing container for parts

was changed when a new bracket was made and it was then necessary to re-form all of the pipes connecting the appliances. Under the present system storage racks for these miscellaneous small brackets are provided and, by conserving the original brackets, the volume of pipe work has been considerably reduced.

The work of repairing superheater units was formerly performed in the blacksmith shop which was over one thousand feet from the nearest pit in the locomotive shop, making it necessary to transport units between the erecting shop and the blacksmith shop by truck. The new superheater-unit repair shop has been installed in Section B-2 of the erecting shop and it served entirely by overhead cranes. This has resulted in the saving of considerable time formerly lost in transporting units and has materially speeded up the work of their repair.

Shop Delivery System

Under the jurisdiction of the stores department a material delivery system has been developed at Sayre which, in conjunction with the progressive spot system, has resulted in a great saving in time in the handling of parts and materials. The delivery trains moving over designated routes are dispatched from a central point and on

regular schedules. No special trips are made. The delivery system not only serves the main locomotive repair shop, but also serves the passenger-car repair department and the enginehouse.

As far as the locomotive work is concerned, the delivery trains move over two general routes, the courses of which are designated by the lines with arrowheads on the shop layout drawing. At fixed locations on these routes are permanent delivery and pick-up stations which are designated by station numbers in circles on the shop layout drawing.

Over route No. 1 tractors with trailers leave the storehouse every hour, beginning at 8 a.m., passing through the blacksmith shop, the east erecting bay, returning through the east machine bay and the blacksmith shop to the storehouse. On each alternate trip the station order is reversed to take care of the movement of material going in opposite directions.

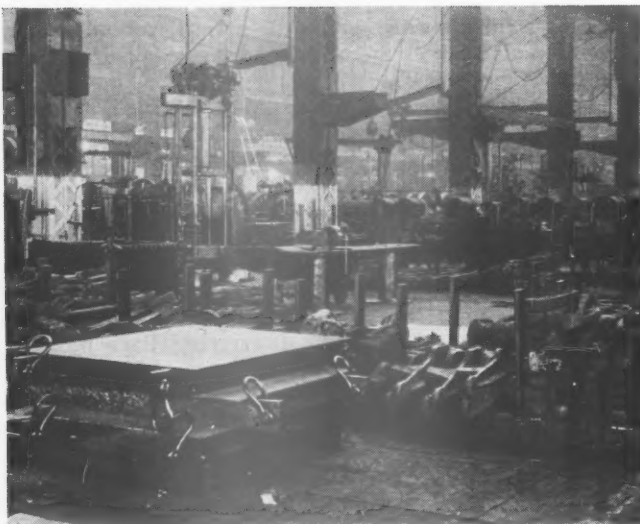
Over route No. 2 tractors with trailers leave the storehouse every hour, beginning at 8 a.m., passing through the blacksmith shop and the west erecting bay, but return through the west machine bay and the blacksmith shop to the storehouse. On this route, as on route 1, on each alternate trip the station order is reversed to take care of the material going in opposite directions. Outside of the main locomotive shop delivery route 2 also goes in the course of its travels to the electric shop and the enginehouse.

These routes are manned by a tractor operator and laborer who handle the movement of all new materials from the stores department to the shops and the movement of all materials and parts between various departments of the shops in the territory covered. The routes are so laid out that they pass all salient points where loads accumulate and deliveries are made.

While there are delivery stations throughout the plants established by the mechanical department, the operators do not arbitrarily make deliveries to these stations, but endeavor to deliver all heavy or bulky material that would require considerable labor in rehandling as near as possible to the point where it is to be used. For instance, rough shoe and wedge castings, crown brasses and driving-box castings, large quantities of rough bolts, etc., are delivered direct to the machines where they are finished. Such items as grates, arch bricks, springs and boiler lagging are delivered direct to the erecting shop pits. The number of trailers carried on each trip varies



The department where the spring rigging is repaired



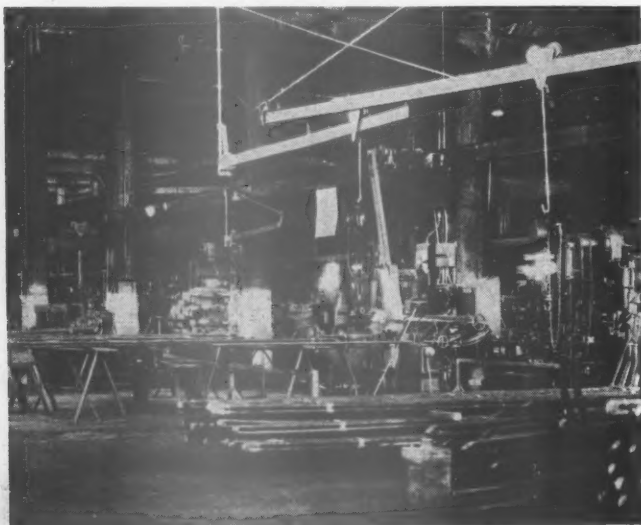
Brake rigging is handled in sets on special platforms

from two to six, depending on the volume of business.

No verbal orders are accepted for transportation service via the delivery system. The delivery of new material is covered by a carbon copy of the material order, which shows the material required and the delivery point. Inter-dependent and inter-shop movements are covered by an inter-shop transportation order. Material and transportation orders are deposited in station boxes by shop foremen and are picked up by tractor operators as they pass along the routes.

New materials orders are brought to the storehouse on the return trip where they are stamped with a time stamp and turned over to the man in charge of loading trailers to be loaded for delivery on the next trip. Any shop transportation orders are examined by the operators and the movement specified is handled on the same trip on which the order is picked up. These orders are then checked as completed by the operators and turned in to the transportation foreman's office on each return trip, where they are time stamped and placed on file.

In addition to the transportation of materials and supplies new applications of the material handling equipment are continually being found. As an example of an operation which is saving considerable money as well as providing a worthwhile service for the mechanical department is the collection and disposal of ashes, refuse



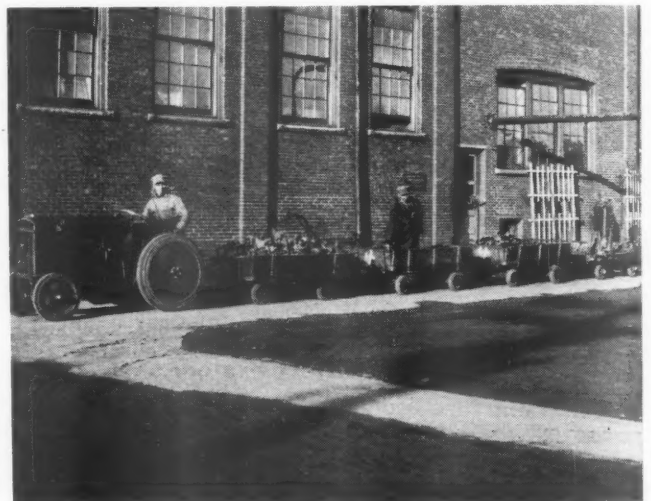
The superheater-unit-repair department

and small scrap which accumulates in and around the repair pits in the locomotive shop. These pits are cleaned once a week and, under the new system, a train is made up of a tractor, three 1½-yd. capacity gravity dump trailers and two standard material trailers equipped with box bodies. This train passes down through the erecting bays, back of the erecting pits, and the accumulation removed from the pits is loaded by shop laborers.

In order to assure the maximum efficiency of the material delivery system approximately 20,000 sq. ft. of concrete roadways of 8-ft. width were laid.

Conclusion

The application of the progressive spot system of locomotive repairs in the Sayre shop has resulted in the concentration of specialized work at a number of fixed points throughout the shop in such a manner that the movement of materials and parts has been confined, in so far as possible, to the shortest possible distances. An effort also has been made to eliminate back-tracking. To the outside observer one condition is especially noticeable—the relative absence of workmen and supervisors moving about the shop. The progressive spot system has to a great extent eliminated the necessity for doing this because of the fact that not only the locomotives, but



Material-delivery train leaving the storehouse

also the materials and parts, come to the workmen—it is rarely necessary for them to leave the department in which they are employed.

The principle of "a place for everything and everything in its place" has been carried out to the highest degree and the result is that even in such small departments as sub-toolrooms the workmen who are responsible for conditions in those departments have become imbued with the idea that an orderly shop is the shortest cut to the way in which to perform a given job with the least effort. Having eliminated a great part of the lost motion within the shops, the entire efforts of the workmen can be devoted to the problem of improving the quality of workmanship on each job performed. Better workmanship and more thorough inspection in the shop brought about as a result of this system are becoming noticeable in the better performance of locomotives on the road. The objective of the management in locomotive repair work is to turn out a locomotive in such a manner that it can perform road service with a minimum of delays due to mechanical causes. The object of this radical step in the method of repairing locomotives has been to assure more dependable service from motive power without increasing the cost of maintenance.

How to Stimulate and Cultivate Goodwill of the Public*

FOR many years the railroads have had to operate under close supervision by municipal, state and federal regulating authorities. Unfortunately, in many instances they have become the football of the politicians. For some reason, hard to comprehend, the general public also seems to believe that the railroads have unlimited resources. As a result, it has been necessary for the railroads, for their own protection and to avoid disaster, to carry on educational campaigns to remove these misunderstandings and improve relationships. Gradually, formal public relations departments have been established on many railroads with a view to organizing and promoting such educational programs.

Public Relations Work Defined

Is it possible for mechanical department officers and employees to be helpful in improving relations between the railroads and the public and, if so, exactly how can they co-operate to the best advantage?

This question was propounded by the Editor to a Public Relations Department Officer who has been unusually successful in stimulating the employees to cultivate goodwill in the territory which his road serves.

"Might it not be well," replied the Public Relations Officer, "before going into details, to agree upon a definition of public relations work? Let me also emphasize the fact that while you speak of me as a public relations officer, we have no formal department of that sort, since our activities are integrated with the entire organization. In defining public relations work the approach usually made is in terms of influencing legislation and regulation, of political conflict, of the economics of railway operation, and of traffic solicitation. Of course, these are part of the task, but they are not the whole task, and I doubt if they give a clear picture of it. I wonder if it is not better to deal with it in terms of interpreting the railroad to the thousands of people who live in the communities which it serves, and whose lives are affected in so many ways by the service it performs. With such a definition it will be plain that the public relations work is the job of every man on the railroad."

"I like your definition," I said, "for it presents a responsibility and an opportunity that includes every employee in the mechanical, as well as all other departments. With this as a background, what is your next suggestion?"

"You have no idea," said he, "how large a proportion of the public is interested in railroad equipment

Public Relations Officer tells Editor how mechanical department officers and employees can help build up goodwill and intelligent interest on part of public

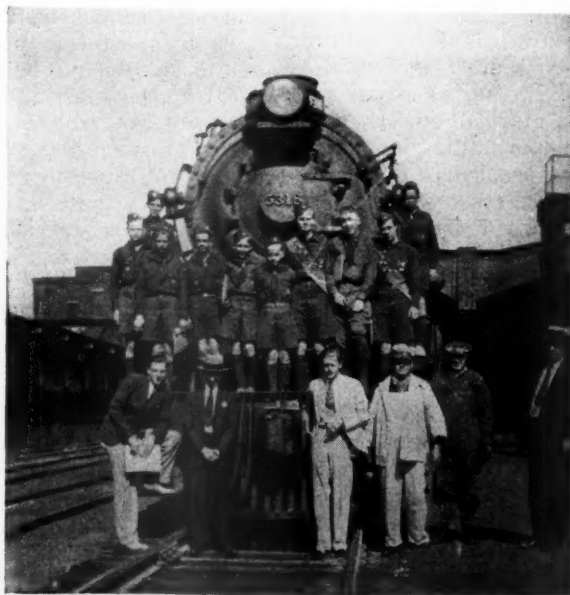
and its operation. We are constantly surprised at the number of 'fans' who have no active relation with the railroads, and yet who follow the equipment improvements, and particularly those on locomotives, with keen interest. Then, too, there are a large number of model makers who use their leisure time in constructing models of cars and locomotives in an attempt to reproduce, in exterior appearance at least, well-known types of locomotives on different railroads. These, however, are only surface indications of an eager interest in such developments on the part of the general public at large."

An editor, of course, has constant reminders of these things in his correspondence and in other contacts with the public. I was rather inclined, however, to question whether the interest was quite as keen and extensive as the Public Relations Officer indicated, and suggested that possibly he had overstated the facts.

New Equipment Attracts Attention

"Let us consider a few specific illustrations in support of my statement," replied the Public Relations Officer. "Take, for instance, the two new, high-speed, streamlined trains that have recently been built for the Union Pacific and the Chicago, Burlington & Quincy.

Crowds have flocked to see these trains wherever they have been placed on exhibition and other thousands have lined the right-of-way when they knew the approximate time at which the trains would pass. It was not unusual to see large groups of school children, who had been excused to go in a body to view the trains as they passed through communities. The Travel and Transport Building at the Century of Progress Exposition at Chicago is among the most popular of the exhibits, and thousands of people pass through the passenger trains and locomotives located in the track exhibit outside the building. By actual count, the number of people who passed through the Union Pacific train on



Boy Scout troop of Paterson, N. J., visits B. & O. terminals in Jersey City

* Thirteenth of a series of interviews with men outside the mechanical department, commenting in a constructive way upon the possibilities of that department.

its tour through the country and at the Century of Progress Exposition is well over a million and a half.

"Transportation always has had a fascination for the average citizen," continued the Public Relations Officer. "The Wings of a Century pageant at the Chicago exposition, which graphically portrays the improvement that has been made in transportation since the early days in this country, is regarded by many as the most interesting and instructive exhibit on the grounds. If you will think back a few years to the Baltimore & Ohio centenary exhibit at Halethorpe, you may recall that it proved a much greater drawing card than the railroad management thought it would be, and had to be continued longer than was anticipated."

"These are rather spectacular developments," I suggested. "I am wondering what the mechanical men can do in the average community that may serve to interest the public and cultivate a more friendly attitude toward the railroad."

Cultivate Showmanship

"While these illustrations are exceptional," replied the Public Relations Officer, "you will find that, if properly promoted and sponsored, the average community will be very much interested in any new development in the locomotive or car equipment, or even in the normal operations of an enginehouse or repair plant. What is needed by railroad managements is an appreciation of showmanship. There is not the slightest doubt in my mind but what people in any community will take advantage in large numbers of an invitation to visit the station or the shops to examine new locomotives or new car equipment, either freight or passenger. The trouble is that the mechanical department people do not appreciate how such things appeal to the general public, and so they do not take the initiative in playing them up.

"In several instances," continued the Public Relations Officer, "the local mechanical department officials have arranged to have groups of school children, Boy Scouts, or the general public make inspection visits to their locomotive and car repair shops. You may say that this is a matter of inconvenience and expense, because it upsets the shop routine and requires the services of employees as guides. If you have no appreciation of what this means in cultivating an interest in the railroad and its problems, then I suppose that from a dollars and cents standpoint it may be regarded as a wasteful expenditure. But I cannot agree with so limited a point of view.

"In the first place," he continued, "such gestures will bring the public in touch with railroad officers on a friendly basis, and will present opportunities for educating the public as to some of the problems of the railroads. In some instances it may mean that young people who have never traveled on a railroad (and there are many such) will become so interested that they will be intrigued into giving it a trial. Surely, no traveler who has gone through an air-conditioned train, even when standing still in the shop or at the station, or on exhibition at some other place, will fail to appreciate the advantages of this type of equipment.

"Let me give you another concrete illustration," said the Public Relations Officer. "One of the cities on our line celebrated an important anniversary. We were asked to place on exhibition in the public square a reproduction of one of the early locomotives which had served this section of the country. This we gladly did, but we also exhibited on a side track, not far away, one of our latest types of locomotives, which today serves this same district. Naturally the public was impressed; many of the people looked the modern locomotive over carefully,

climbing into the cab and examining and asking questions about the different gadgets."

Talking to the Public

"Do your mechanical department people have any opportunities of speaking to the public?"

"Yes," replied the Public Relations Officer, "and some of them are doing fine work. Our mechanical department employees should avail themselves of every opportunity to speak before Chambers of Commerce, service clubs, Boy Scouts, schools, or any other group to which they may be invited. If I were to make any criticism of these talks, I would say that in too many instances the speakers are over-ambitious, the danger being that they will shoot over the heads of the people. The man who can make a simple, plain talk about that part of railroading in which he is specially engaged, may register much better results than one who attempts to give a scholarly discussion of some of the larger railroad problems.

"The people in a local community, for instance," he continued, "will be specially interested in data as to that part of the payroll which comes to their community, with a break-down as to how it is expended for various purposes. Many of the communities in which large shops or car repair points or engine terminals are located, depend to a very large extent on the money expended by railroad employees. It is well to remind them of this and in such simple terms that its import can readily be grasped. There are also splendid opportunities for getting over the extent to which the railroads are taxed, or the way in which they are discriminated against by subsidized types of carriers who do not have to conform to the rigid regulations which control the railroads."

Railroads Need Boosters

"Is it possible for the mechanical department employees to assist in securing traffic?" I asked.

"In many instances, yes," replied the Public Relations Officer. "We have concrete illustrations of this in the splendid accomplishments of booster clubs on many railroads, just as we know that favorable opinion has been created for the railroads in many places by the formation of railroad employees' and taxpayers' associations. Mechanical department employees, if they will join with other members of the railroad family, can by their very numbers make a strong impression upon the community, and this should be reflected in a more tolerant and friendly spirit—and in more consideration on the part of the law making and regulating authorities."

"It appears that the employees of the mechanical department can render even larger services than I anticipated," I suggested. "They have much the same possibilities of using their influence as employees of other departments, but as you have so clearly pointed out, there are also special ways in which they can be of service."

"Quite right," replied the officer. "I have no doubt, also, but that the opportunities for public relations work can be more fully developed. Many people fail to do things that they could do, because they are not spectacular. Addressing a public meeting is a spectacular thing, but it is often possible to exert a wider influence through the less spectacular method of simply talking with one's friends. There are a million railway employees in the country and if every one of them would undertake to 'sell' the railroads to a score of people, there would be no problem of adverse legislation and restrictive regulation. The fact that the public is interested in the development of cars and locomotives opens up innumerable opportunities for effective public relations work by officers and employees of the mechanical department."

Roller Bearings for Main and Side Rods on D. & H. Locomotives

By B. W. Taylor*

S K F bearings for rods and main driving boxes have been operated satisfactorily in over 25,000 miles of heavy passenger service

AN article describing roller-bearing journal applications for the engine truck, drivers and tender trucks of a Hudson type locomotive on the New York Central, with some observations on performance after 130,000 miles in high-speed passenger service, also a brief resume of the development of anti-friction bearings for locomotives generally, appeared in the *Railway Mechanical Engineer*, November, 1932, page 451. Satisfactory results on this and a considerable number of other locomotives justified experiments in the use of such bearings on main rods and side rods in an effort to improve still further the mechanical design of locomotives.

On February 2, 1934, the Delaware & Hudson placed in service locomotive No. 609, 4-6-2 type, equipped with S K F anti-friction bearings on the back ends of the main rods and the main sections of the side rods. Bearings of the same type were also applied on the main driving axle boxes.

This engine is used in high-speed passenger service, handling express and limited trains between Albany, N. Y., and Montreal, P. Q., as well as some local movements. The mileage to June 1, 1934, was approximately 25,000, of which 9,052 miles were made during the month of May.

This locomotive is the first to be equipped by any road in America with anti-friction bearings on the rods and placed in regular revenue service and, so far as the author can learn, it is the first in the world for any engine of comparable size and speed. Within the last two months another Pacific type engine of about the same size has been equipped with anti-friction rod bearings and placed in service on one of the large Eastern systems.

Locomotive 609 exerts a tractive force of 42,750 lb.,

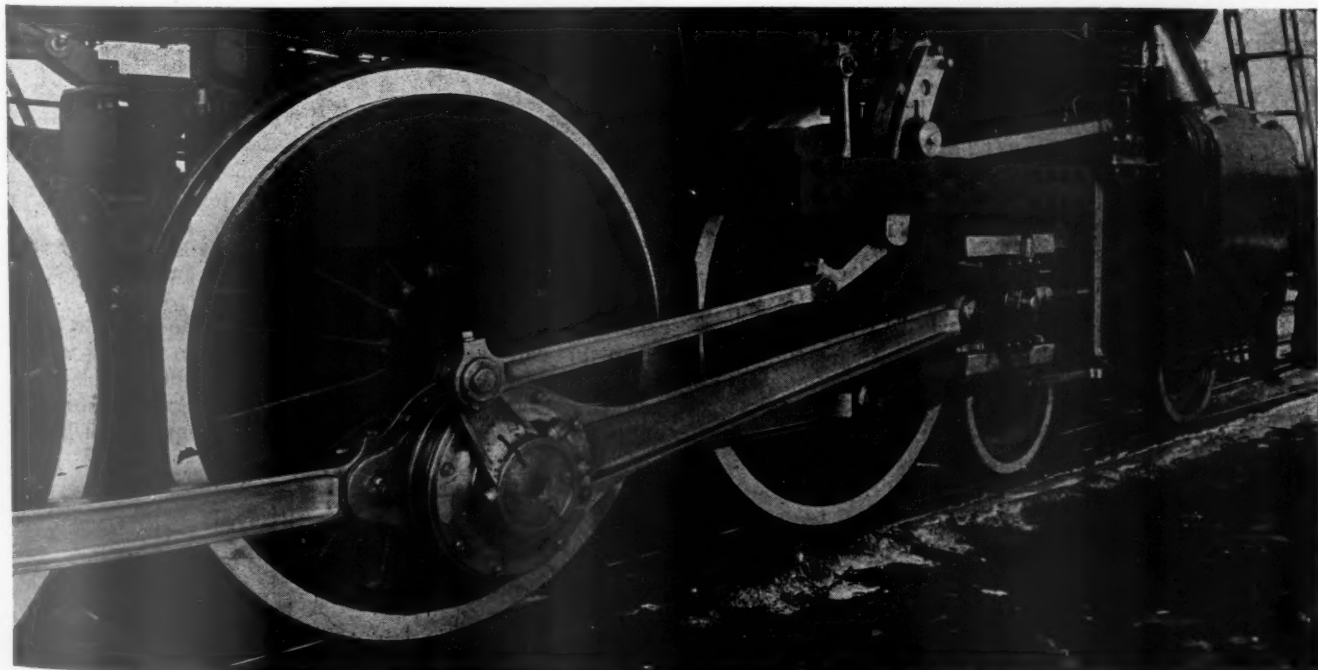
*Railway engineer, S K F Industries, Inc., Philadelphia, Pa.

with cylinders 24 in. by 28 in. and driving wheels 73 in. in diameter. The boiler operates at a pressure of 225 lb. The total weight of the engine is 295,000 lb., of which 192,500 lb. is carried on the driving wheels. Other principal dimensions and weights are shown in the table.

The locomotive was originally built by the American Locomotive Company in 1914, and an opportunity for applying anti-friction bearings was afforded by the rebuilding of the engine at the railroad company's Colonie (N. Y.) shops. The Delaware & Hudson, the American Locomotive Company and the S K F Industries, Inc., jointly carried out this work, the builder supplying the main driving-axle assembly complete with wheels, bearings, boxes and rods to the road for installation. This involved a considerable amount of design work by the builder on rods and pins to get proper counter-balancing with anti-friction bearings.

The Bearing Application

The same size bearing is used both for the back end of the main rod and the main section of the side rods, the bearing for the former having a tapered bore and tapered sleeve to secure the inner race to the crank pin and the



S K F roller bearings are applied to main and side rods at main pin connection on D. & H. locomotive No. 609

latter a straight bore with press fit mounting. This arrangement lends itself to the proportioning of the pin for strength in bending and in a large degree at least to convenience in mounting and dismounting rods. Bearing dimensions are as follows: Outside diameter, 16.5364 in.; width, 5.4330 in.; bore for the side-rod bearing, 8.6614 in., and for the tapered sleeve used with the main rod bearing, 7.8740 in. This gives approximate crank-pin diameters of $8\frac{11}{16}$ in. and $7\frac{7}{8}$ in., at the side-rod and main-rod locations, respectively. The maximum piston thrust is 102,000 lb., approximately; cylinder centers, 91 in., and frame centers, 41 in.

The bearings are of the S K F spherical self-aligning type, with two rows of rollers, a spherical outer race, and positive guiding on the inner race. All parts of the bearing, except the two retainers, are of carbon-chromium steel hardened throughout, ground and polished. The retainers are made of bronze and serve to space the rollers properly. Their weight is carried on the raised central section of the inner race known as the "inner-race land." This is essential for any bearing operating on a crank pin, otherwise the effect of centrifugal force would be to wedge the rollers in the retainer pockets, thereby producing lubrication difficulties and high stresses in the retainers. The bearing is a self-contained, non-adjustable unit, a thrust and radial load carrier, and within the limits of clearance between the sides of the rod ends affords flexibility and alinement for the rods with respect to the main driving axle, for any position which the latter may take with respect to the frame. Such flexibility goes far to eliminate many of the troubles experienced with several types of rod bearings now in use. Stability for the rods at the other ends is obtained from the friction bearings on the crosshead pin, and from the crank pin on the front driver.

In mounting the bearings on the pins the basic principle is to remove practically all radial looseness from the assembly. This is done by expanding the inner races in mounting and making the outer races tight fits in the rod ends. Before mounting, the radial looseness in the bearings is 0.0035 in. to 0.0045 in. The inside bearing is heated in oil and shrunk on the pin and the outer one secured by driving up the tapered sleeve (taper 1 in 12) to secure rigidly the inner race to the pin, at the same time measuring the expansion of the inner race with thickness gages inserted between the rollers and the outer race. A threaded extension on the tapered sleeve is provided to take a wing nut which will withdraw the sleeve when the main rod has to be dismantled. The outer race in the main rod is mounted with a press fit approximately 0.0015 in. tight, but the fit in the side-rod end is lighter since this rod must be mounted with the bearing on the pin. The tapered sleeve is locked by axial pressure from the eccentric crank exerted against a steel plate (which also serves to close the split in the eccentric crank) and a shim. The eccentric crank itself and its location are in accordance with common practice.

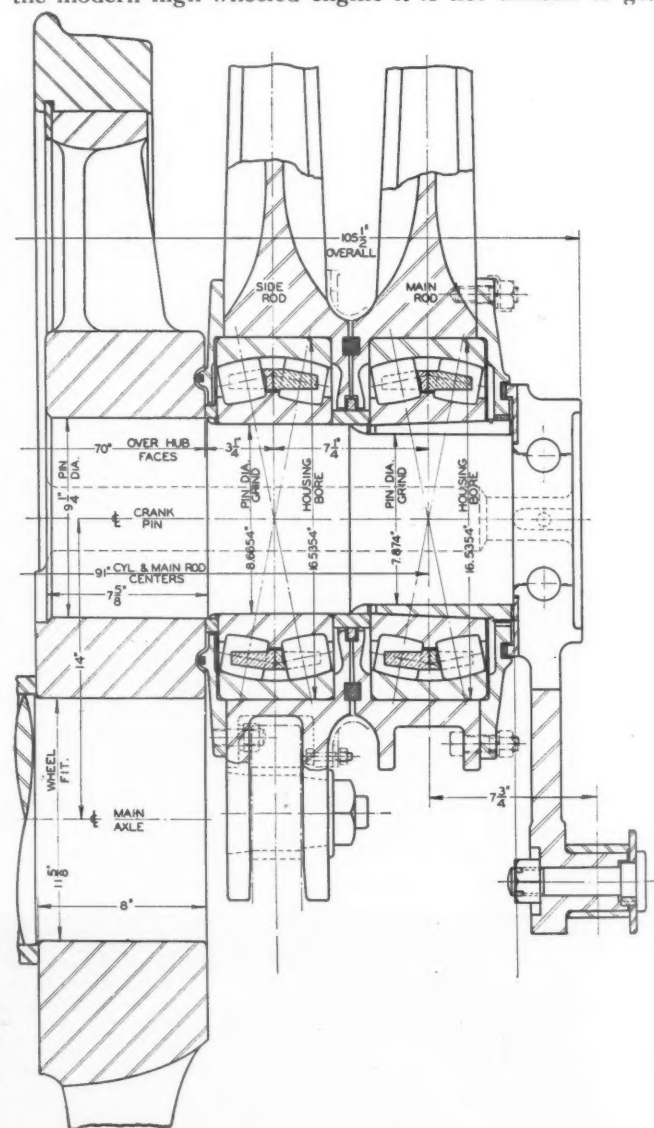
The crank pin and the rods are of nickel alloy steel, heat-treated, and a considerable saving in weight of these parts has been effected by careful design of the rod sections. The pin is hollow bored and ground on the outside diameter for the bearing fits.

It is of particular interest to note the difference in weight on the main driving axle at the rail with friction bearings and with anti-friction bearings. Scale weights are not available, but calculations indicate that there is an increase of 2,300 lb. with anti-friction bearings, of which 900 lb. is chargeable to the rod-bearing applications and 1,400 lb. to the driving boxes and bearings.

In selecting bearings for the main pin it was necessary to consider bearing capacity in relation to the space

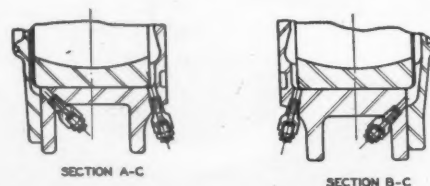
available for bearings. The required bearing capacity for adequate life is obtained from calculations based on piston thrust and the inertia effect of the reciprocating parts. The space available for bearings is either influenced or directly fixed by the following: Driving-wheel diameter, pin size, weight for counterbalancing, distance between frame centers and distance between cylinder centers.

The effect of wheel diameter is not great, and with the modern high-wheeled engine it is not difficult to get



Section through crank pin showing detailed construction of roller bearing application to main and side rods

the necessary clearance over the top of the rail. In general, this can be obtained with a minimum driving wheel diameter of 66 in. (new tires). With alloy steels now available crank-pin diameters can be reduced a sufficient amount to accommodate the design without jeopardizing



Section A-C through side rod and section B-C through main rod showing grease fittings

the strength of the pin. This also applies to the rods used, particularly to the sections of the rod ends. The figures given on the weights of the parts for counterbalancing give some idea of the possibilities here, which, in the development of this particular design, were something of a surprise. The distance between cylinder centers is of primary importance. It definitely and finally fixes the length of the pin to the center line of the main rod, hence, the width of the bearings and the space available for grease and grease seals. This dimension usually varies between 89 in. and 93 in. for different locomotives. In this case, it is 91 in.

Counterbalancing

The table giving weights of parts for counterbalancing shows how this problem was solved by the American Locomotive Company and the railroad. The figures are approximate, as some are actual and others estimated weights, but they fairly represent the conditions. As originally built the locomotive was counterbalanced for all of the revolving weights and approximately 62.7 per cent of the reciprocating weights*, but when the engine was rebuilt and anti-friction bearings applied, it was cross-balanced. This must be taken into account in comparing the two conditions and allowance also must be made for the fact that changes from the original design had increased the weight of the reciprocating parts.

Comparison of Counterbalances for Change in Reciprocating Parts—Re-Built Engine

Net reciprocating balance	Anti-friction bearings	Friction bearings
Actual	762	1109
	1860	1765
Comparison based on	762	1109
Original engine	1692	1765
Comparison based on	762	1109
Re-built engine	1860	1933

Counterbalance Weight Table—Main Drivers

	Anti-friction bearings	Friction bearings
Weight side rod on front pin....	123 lb.	135 lb.
Weight side rod on back pin....	125 lb.	148 lb.
Weight side rod on back pin (incl. roller bearing and all parts) (A)	670 lb.	472 lb.
Weight back end main rod (incl. roller bearings and all parts) (B)	649 lb.	520 lb.
Weight eccentric crank equivalent (C)	80 lb.	66 lb.*
Weight cross-balance, revolving parts (D)	294 lb.	0 lb.
A + B + C + D	1,693 lb.	1,058 lb.
Weight on main pin to balance block	1,953 lb.	1,500 lb.
Reciprocating weight main wheel..	260 lb.	442 lb.
Weight on front or back pin to balance block	375 lb.	475 lb. 475 lb.
Avg. revolving weight front or back pin	124 lb.	135 lb. 148 lb.
Reciprocating weight front or back pin	251 lb.	340 lb. 327 lb.
Total, front and back pins	502 lb.	667 lb.
Same—main wheel	260 lb.	442 lb.
Total reciprocating weight per side	762 lb.	1,109 lb.
Reciprocating weights:		
Front end—main rod	290 lb.	363 lb.†
Crosshead	806 lb.	719 lb.
Piston and rod	735 lb.	660 lb.
Union link	29 lb.	23 lb.‡
Total	1,860 lb.	1,765 lb.
Net reciprocating	762 lb. = 40.9 per cent	1,109 lb. = 62.7 per cent
Balance	1,860 lb.	1,765 lb.

* New and heavier crank for rebuilt engine.
† Alloy steel rod lighter for roller bearings.
‡ Changed other parts for rebuilt engine.

These are noted in the remarks column in the table and the table of comparison of counterbalances further illustrates this. The principal purpose of the data given is to show that the counterbalancing problem can be satisfactorily solved when anti-friction bearings are used.

The dynamic augment at diameter speed is given by the following expression:

$$D = W \times 3.2 \times \frac{S}{2}$$

where D = dynamic augment, lb.
W = overbalance, lb.
S = stroke in inches

For the locomotive with friction bearings

$$D = (1,500-1,058) \times 3.2 \times \frac{28}{2} = 19,800 \text{ lb.}$$

and cross-balanced with anti-friction bearings

$$D = (1,953-1,693) \times 3.2 \times \frac{28}{2} = 11,640 \text{ lb.}$$

Method of Lubrication

The lubricant used is grease, introduced into the bearings by an Alemite gun of 13 oz. capacity. One of the accompanying sectional drawings shows the fittings, two per rod end, and so arranged as to supply independently grease to each side of each bearing. This is to afford the lubricant as much opportunity as possible to get into the bearings and lubricate the inner-race guide rails in con-



Main driving-wheel and axle assembly with roller bearings for main and side rods and for driving boxes

tact with the roller ends, as well as the cage contact on the inner-race land. The grease capacity of each rod end is 52 oz. approximately.

A great deal of attention has been given to the service requirements for lubrication, as this is an important factor in operation. Tests have shown that the locomotive can be safely operated 500 miles in through service without the addition of any grease, but the present practice is to add approximately one-half a gun full to each of the main rods and about a gun full to each of the side

* See report of Committee on Locomotive Design and Construction, A.R.A. Mechanical Division, 1930, for methods of counterbalancing. An abstract of this report was given in the *Railway Mechanical Engineer*, August, 1930, page 448.

rods per trip of 240 miles. There is an inspection hole on the front cover of the main rod, but none on the side rod, and there seems to be more loss of grease at the seal nearest the wheel hub than from the others, hence the greater quantity added to the side-rod bearings. The grease that is lost is thrown out from the rod ends due to the action of centrifugal force, the small space available, and the pressure produced by the rolling elements in the bearings. Further experiments are being made to determine the minimum grease required, maximum safe mileage between greasings and to improve all of the seals by the use of more effective packing. The labyrinth clearances must be $\frac{1}{8}$ in. approximately on the radius, to allow the rods to align relative to each other and to the pin. New seals will be ready for application at the first convenient shopping of the locomotive.

The first grease used was very light in consistency, having about 14 per cent soda-lime soap, in order to get

the maximum flow of grease into the bearings and between the two rows of rollers. This was followed by a heavier grease with 19 per cent soap content. The latter is of about the so-called No. 2 consistency and is used at present. Both greases provided satisfactory lubrication, but the heavier grease is somewhat easier to retain in the rod ends. Tests are contemplated with a still heavier grease, but one which would still be much lighter than the ordinary rod grease for friction bearings.

Performance in Service

The basic principle in making the application was to reduce to a minimum the clearance between moving parts in the main driving mechanism of the locomotive and to keep these clearances at a minimum from shopping to shopping. The driving boxes are fitted with 0.010 in. total clearance in the pedestals and no wedges are used. There is practically no wear after 25,000 miles and experience has shown that approximately 150,000 miles can be operated without shop or enginehouse attention at this location.*

The rod bearings are assembled with zero radial clearance and actually this can be obtained within a tolerance of 0.001 in. The resulting absence of box pound and rod pound is very noticeable in the operation of the engine. With friction bearings there is a pronounced slapping of the rods when the engine is coasting or operating under small throttle opening, which is absent here. With anti-friction bearings the elimination of many of the heavy shocks and impacts to which the frame and motion work generally are ordinarily subjected reduces the stresses in these parts and lowers the maintenance on them.

The rod-bearing temperatures are atmospheric, plus 30 to 40 deg. F. The locomotive has operated satisfactorily at temperatures varying from 40 deg. F. below zero last winter in the Adirondack mountains to the present summer temperatures, with satisfactory lubrication and using the same grade of grease throughout.

Observations in service to determine nosing and side sway indicate that the engine is steady and has good riding qualities. Further tests and observations are to be carried out to determine all of the advantages and economies which may properly be charged to the application and to improve and extend its use as far as seems desirable.

* See *Railway Mechanical Engineer*, November, 1932, page 451, "Roller Bearings on Driving Journals Show Economies."

Steam Throttle Valve For Air Compressors

TO prevent racing and protect air compressors against damage when operating at low main reservoir pressure the New York Air Brake Company, 420 Lexington avenue, New York, has designed a special throttling valve which is inserted between the turret valve and the governor in the steam supply line leading to the air compressor on the locomotive. The function of this valve is to restrict the flow of steam to the pump at times when the main reservoir air pressure is extremely low, or during the start of charging the main reservoirs.

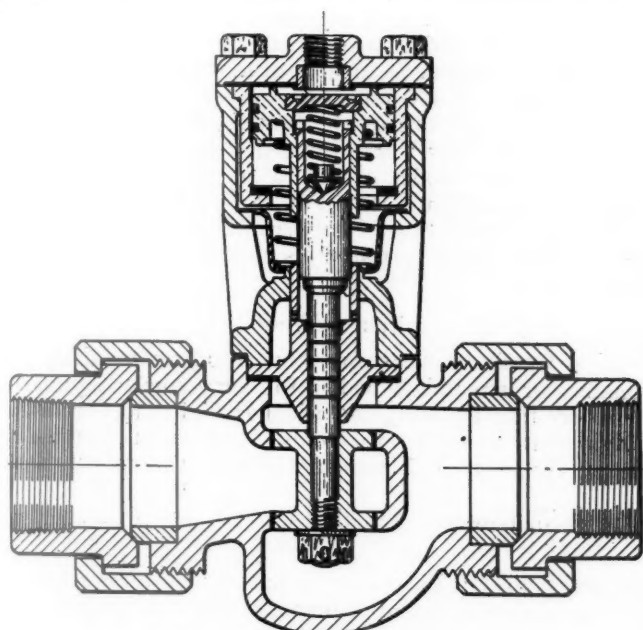
When charging is started in the main reservoir should there be an absence of air therein and full steam pressure is permitted to flow immediately into the air compressors, there is a tendency for the compressor to race due to the absence of an air cushion under the pistons. Oft-

Table of Dimensions, Weights and Proportions of Delaware & Hudson Locomotive No. 609 Equipped with S K F Bearings

Railroad.....	Delaware & Hudson
Builder.....	American Locomotive Co.
Type of Locomotive.....	4-6-2
Service.....	Passenger
Cylinders, diameter and stroke.....	24 in. by 28 in.
Valve gear, type.....	Walschaert
Valves, piston type:	
Maximum travel.....	6½ in.
Steam lap.....	1½ in.
Exhaust clearance.....	9/16 in.
Lead full gear.....	Front 0, Back 9/16 in.
Cut-off in full gear, per cent.....	.85
Weights in working order:	
On drivers.....	192,500 lb.
On front truck.....	47,500 lb.
On trailing truck.....	55,000 lb.
Total engine.....	295,000 lb.
Tender, loaded (¾ load, coal and water).....	160,500 lb.
Total engine and tender.....	455,500 lb.
Wheel bases:	
Driving.....	13 ft. 0 in.
Total engine.....	34 ft. 10 in.
Total engine and tender.....	76 ft. 8 in.
Wheels, diameter outside tires:	
Driving.....	73 in.
Front truck.....	33 in.
Trailing truck.....	45 in.
Journals, diameter and length:	
Driving, main SKF roller bearings.....	11 in. by 13 in. nominal
Driving, others.....	11 in. by 13 in.
Front truck.....	6½ in. by 12 in.
Trailing truck.....	8½ in. by 16 in.
Boiler:	
Type.....	Radial stay, straight top
Steam pressure.....	225 lb.
Fuel.....	Bituminous coal
Diameter, first ring, inside.....	76 7/16 in.
Firebox, length and width.....	132½ in. by 108½ in.
Height bottom of firebox ring to crown sheet, front.....	84 in.
Height bottom of firebox ring to crown sheet, back.....	63½ in.
Arch tubes, number.....	5
Combustion chamber.....	None
Tubes, number and outside diameter.....	252-2 in.
Flues, number and diameter.....	34-5-¾ in.
Length over tube sheets.....	20 ft. 0 in.
Grate area.....	99.32 sq. ft.
Heating surfaces:	
Firebox.....	277 sq. ft.
Arch tubes.....	40 sq. ft.
Tubes and flues.....	3579 sq. ft.
Total evaporative.....	3896 sq. ft.
Superheating.....	840 sq. ft.
Comb. evaporative and superheating.....	4736 sq. ft.
Tender:	
Style.....	Rectangular, water-bottom
Water capacity.....	11,000 gal.
Fuel capacity.....	14 tons
Journals, diameter and length.....	6½ in. by 12 in.
General data estimated:	
Rated tractive force.....	42,750 lb.
Weight proportions:	
Weight on drivers ÷ total weight, engine, per cent.....	65.2
Weight on drivers ÷ tractive force.....	4.50
Total weight engine ÷ comb. heat. surface.....	62.4
Boiler proportions:	
Tractive force, engine ÷ comb. heat. surface.....	9.05
Tractive force, engine x dia. driver ÷ comb. heat. surface.....	.660
Firebox heat. surface ÷ grate area.....	3.19
Firebox heat. surface, per cent of evap. heat. surface.....	8.14
Superheat, surface, per cent of evap. heat. surface.....	21.6

times the pistons are forced so hard against the end of the air cylinders that the piston heads become loosened from the piston rods, resulting in a pump failure. To eliminate this it is proposed to restrict the flow of steam to the compressors until such time as the main reservoir air pressure is built up to a predetermined pressure, for example 40 lb., at which time a suitable air cushion behind the air pistons is established to permit full steam throttle opening without damage to the compressor operating parts.

Referring to the drawing, the left-hand opening of the lower portion is connected to the steam supply and the right-hand opening to the air compressor. Between these openings a plug valve is interposed. This valve is attached to a valve stem which is collapsibly connected to a piston in the upper part of the throttle valve, the space above the piston being connected to the air pipe leading from the main reservoir to the high pressure top of the duplex pump governor. While the pressure in the main reservoir is low, all parts are in the position shown and the flow of steam to the air compressor is restricted to the amount that can pass the loosely fitting plug valve.



Air compressor throttle valve

As will be noted, the piston is provided with a sealing rim on its upper face which seats on the top gasket so that only the surface inside of the rim is subjected to air pressure. When main reservoir pressure reaches about 40 lb., the piston is forced down against the resistance of the outer spring and opens the plug valve. As soon as the piston starts downward and the rim seal is broken, the effective area is increased to that of the full piston diameter. The piston will now make its full stroke, overcoming the resistance of both the outer and inner springs and seat itself against the gasket in the bottom of the piston chamber and thus prevent any leakage from the main reservoir to the atmosphere below the piston. The piston and valve stem being collapsibly connected, the downward movement permits the enlarged portion of the valve stem to seat against its guide and form a seal against steam leakage past the lower part of the valve stem to the atmosphere.

When operating against low reservoir pressures, the pump is limited to 40 to 45 cycles per minute and when the throttle valve opens, the speed is immediately increased to say 80 to 90 cycles.

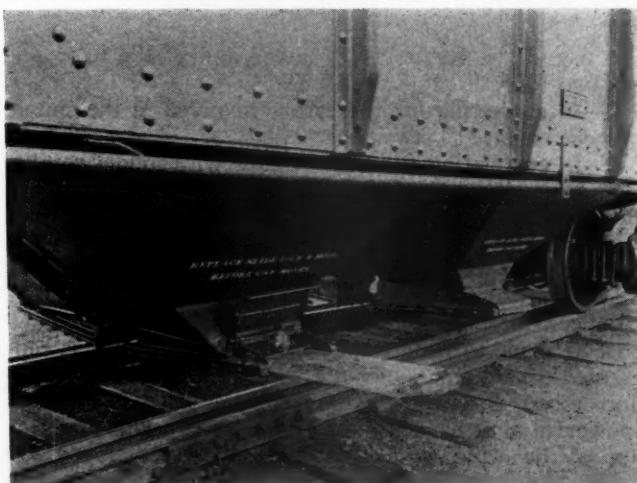
Discharge Gates for Bulk Cement Cars

THE growth of the use of ready mixed concrete, or batch mixed concrete, has made it necessary for several railroads to provide special cars for a more satisfactory handling in bulk of the required cement. The majority of these cars have been converted from 55-ton, twin-hopper, coal cars by the addition of a water-tight roof provided with covered hatch openings. Interior bulkheads are also fitted to limit the cubical capacity to suit the increased weight of cement, which averages about 85 lb. per cubic foot as loaded. The hoppers are modified from the usual door arrangement to that of special discharge gates which are suitable for use with the type of conveying system employed in unloading this material.

Certain railroads are also converting some box cars for the handling of bulk material, fitting them with covered roof hatches and with hoppers below the flooring, the discharge gates for these hoppers being similar to those used on the hopper type cars.

The Wine Railway Appliance Company, Toledo, Ohio, has developed for these types of cars a discharge gate having an electric steel casting frame which extends entirely around the hopper openings and is riveted thereto. Below this upper frame is secured a lower frame which carries the guides for the slide and grooves for the unloading connection, the contacting surfaces of the two frames being finished to assure a perfect assembly. Between these frame members is a sliding gate, provided with a handhole for operating, and a pawl for locking and sealing the gate in closed position. The operating end of the assembled gate is covered by a weather tight shield which may also be sealed. The whole gate is of rigid construction to prevent the weave in the car body from influencing the alinement of the frames, or the sliding member, and to withstand the hard usage of this service. These discharge gates are furnished by the manufacturer as a completely assembled unit ready for application to the modified hopper sheets.

There are other possible uses for cars of this type, such as the handling of lime, glass sand, furnace lining, pulverized coal, or almost any bulk material which must be kept dry in transit, yet can be unloaded by gravity to an advantage. Some of these, as well as certain other materials, are already being handled in limited quantities in covered hopper bottom cars.



Wine type "A" discharge gate for bulk cement cars—Near gate open and others closed with the weather shields down

Aerodynamics of the Railway Train

AS an introduction to the evaluation of the air resistance of the railway train, it is necessary to set down one or two fundamental formulae.

The fundamental equation of air resistance may be written in the form

$$R = C \left(\rho \frac{v^2}{2} \right) A$$

where

R = the resistance in lb.
 ρ = the density per cu. ft.
 v = the speed in ft. per sec.
 A = the frontal area in sq. ft.
 C = the absolute coefficient of resistance

Engineers very often prefer to combine the density with the constant C considering the density to be that of standard air at 60 deg. F. and 760 m.m. pressure, and also to use the velocity in miles per hour. The equation then becomes

$$R = K A V^2$$

where K = the "engineer's coefficient of resistance"
 V = velocity in miles per hour.

This equation assumes that air resistance varies as the area and the square of the speed. While turbulent or eddy making resistance does vary in this fashion, skin friction follows a different law. Thus, skin friction varies as

$$R = b l^{.85} v^{1.85}$$

where b is the breadth of a flat plate and
 l is the length of a flat plate

Dimensional analysis indicates that the eddy or whirling resistance and the viscous drag may be combined in the form

$$R = C \frac{\rho}{2} A v^2 \left(\frac{v l}{\nu} \right)^n$$

where n = a small negative exponent,
 l = the length of the body
 ν = the coefficient of kinematic viscosity.

The expression $\frac{v l}{\nu}$ is known as the Reynolds' Number.

The use of the Reynolds' Number and of the exponent n is two fold:

1—In correcting for the errors involved in the simple "velocity-squared" law.

2—In correlating full scale values with model results.

In comparative work it is generally possible to use the simple squared law. The appropriate use of the Reynolds' Number correction will be fully covered in these articles, even though space will not allow us to give its full theoretical derivation.

In considering train aerodynamics, some reference must be made to wind tunnel methods. In Fig. 1 is represented diagrammatically the wind tunnel at New York University, in which a large propeller type fan creates a powerful airstream in the working or experimental section of the wind tunnel. The methods employed for making the flow smooth and steady with as little pressure gradient as possible, and for control of the tunnel speed

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By Alexander Klemin*

Part I—Wind-tunnel experimental methods—Use of Reynolds' Number in determining scale effect

are interesting, but do not concern us here. In Fig. 2 are represented also diagrammatically the six automatic balances and suspension wires which are employed for making measurements. It is possible with such equipment to measure forces along three axes at right angles to one another, and also the moments about such axes.

Certain limitations as to sizes of models naturally exist and the model should not have a cross-section too large in relation to the size of the tunnel. By certain modifications of the New York University tunnel it is possible to test a scale model of say a locomotive and eight coaches to a maximum length of 25 ft. There is possible a wind speed variation of between 10 and 110 miles per hour. Such speed variation is useful in investigating scale effects.

Scale Effect

It is found in measuring the aerodynamic drag of rounded or streamline bodies for very small Reynolds' Numbers that the drag coefficient is high and decreases rather sharply as the Reynolds' Number is decreased. Once a certain critical boundary layer Reynolds' Number

is reached, however, and the product $\frac{\delta v}{\nu}$ where δ =

boundary layer thickness, v = speed of the air stream, and ν = coefficient of kinematic viscosity assumes a

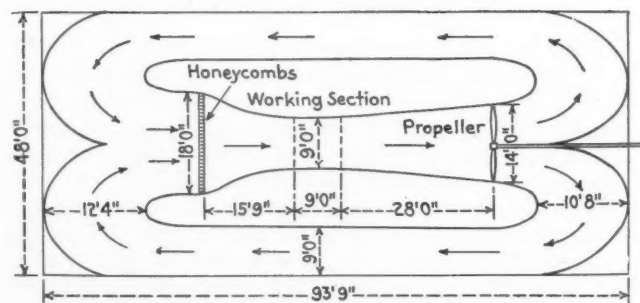


Fig. 1—Plan view of wind tunnel

certain value, the flow changes from a laminar flow to a turbulent flow, and the drag coefficient thereafter assumes an asymptotic, or very slowly decreasing value. The coefficient of drag of a long cylinder when plotted

against $\frac{d v}{\nu}$ (where d is the diameter of the cylinder) as

in Fig. 3 gives a typical picture of the variation of the drag coefficient with the Reynolds' Number of the body

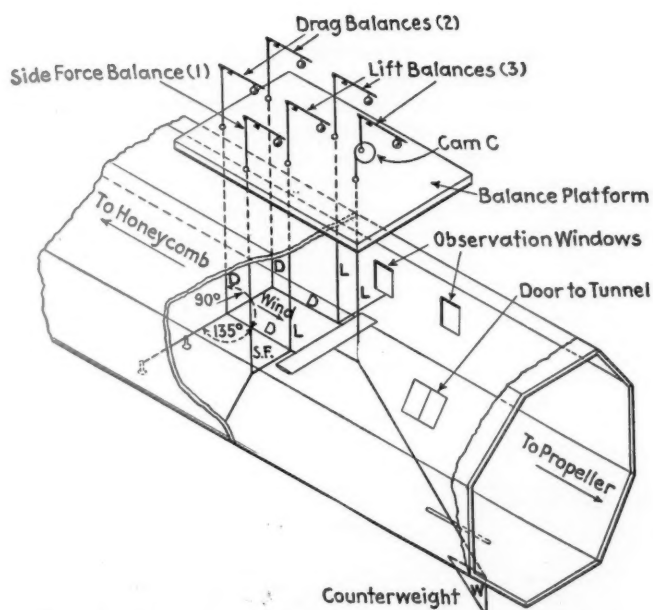


Fig. 2—Suspension of model to wind-tunnel balances

as a whole as well as its finally asymptotic character.

It is important therefore that test of trains should be made beyond the critical Reynolds' Number. Fortunately the critical number for streamline trains is only about 100,000¹ and this is greatly exceeded in a modern wind tunnel such as that previously described.

Once the critical number has been passed, extrapolation becomes fairly easy. Thus wind-tunnel tests made on air ships to a scale as low as 1:134 have been checked quite closely by full scale deceleration tests and the ex-

ponent n in the equation $R = C \frac{\rho}{2} A v^2 \left(\frac{lv}{v} \right)^n$ is found

to have quite a low value even for a "fine," well streamlined airship. Again in wind-tunnel tests of various types of airplanes, the writer has found that n has a numerical negative value never greater than $-.09$, and computations of airplane performance have been checked again and again by full flight tests with an accuracy regarding top speed of ± 2 per cent.

For trains extrapolation for full scale resistance should be considerably easier than for either airships or airplanes. First of all, the scale of the model can be larger than in the case of an airship or a larger airplane. Second, the tunnel speed can be made equal to or greater than the speed of the train, whereas airplane flying speed may be several times as great as the tunnel speed. Again the train is not likely to be, for some time at least, nearly as perfect a streamlined object as the airship or the airplane at zero lift for the following reasons:

The railway train cannot be streamlined in plan form; neither the head car nor the tail car can be designed in perfect accord with streamline principles; the presence of the ground must destroy the symmetry of the flow to some extent; a train is likely to experience a cross-wind or lift force, and this in turn produces appreciable drag in an object as narrow as a railroad train. A justifiable

hypothesis is therefore that while the law $R = C \frac{\rho}{2} A v^2 \left(\frac{lv}{v} \right)^n$ applies to the streamline train, the value of n

¹ Air Resistance of High-Speed Trains and Interurban Cars. O. G. Tietjens and K. C. Ripley. A.S.M.E. Applied Mech., Sept., 1932. See also the Railway Mechanical Engineer for Jan., 1932, page 18.

should be much smaller than in the case of the airship or the very clean airplane. We will examine such experimental evidence as is available.

In the tests of a freely suspended 1:12 scale model of a C.N.R.² locomotive and tender the following were obtained for the resistance coefficient (including the suspension wires):

Wind speed ft. per sec.	$\frac{R}{V^2} \times 100$
20	0.133
30	.136
40	.139
50	.139
60	.141
70.4	.140
70.8	.140
90	.141
100	.142
110.5	.142
120	.141
154	.142
170.2	.140

In spite of the fact that suspension wires were included in the measurements, the drag coefficient remained substantially constant beyond a speed of 50 ft. per sec. Certainly in extrapolating to full scale for an unstreamlined locomotive scale corrections would not be applied, and the $A v^2$ law followed exactly.

Early experiments by Dr. Klemperer at Friedrichshafen³ on unstreamlined automobiles and cars streamlined on the Jaray principle showed the resistance to vary as v^2 , independent of the Reynolds' Number, for all the types of cars tested.

Rumpler's experiments⁴ at Göttingen also with varying types of automobiles gave the same result.

Professor W. E. Lay at the University of Michigan, also in tests of automobile bodies⁵ ran the tunnel at various speeds but took average values throughout, indicat-

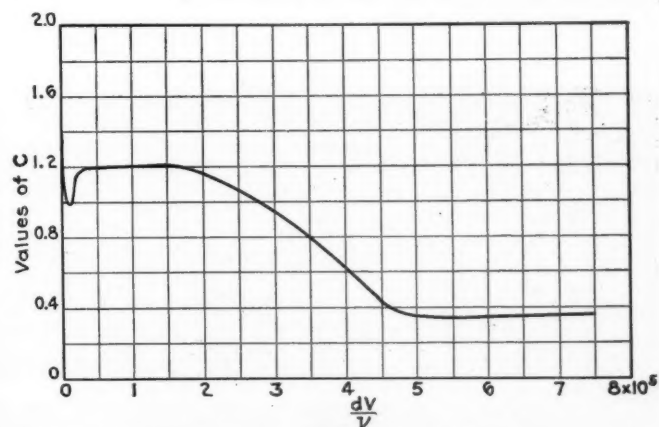


Fig. 3—Coefficient of air resistance for a long cylinder as a function of the Reynolds' Number

ing apparently that no scale effects were found. So did R. H. Heald at the Bureau of Standards.⁶ Dr. Tietjens⁷, discussing the effects of varying Reynolds' Number, concludes that once tests are run beyond a number of 100,000 coefficients will not vary greatly with scale effect.

Tests on the model of a 1934 Sedan at New York

² G. G. Green, The Wind Tunnel Development of a Proposed External Form for Steam Locomotive, Canadian Journal of Research, 1933. See also the Railway Mechanical Engineer for May, 1933, page 149, and June, 1933, page 204.

³ W. Klemperer, Luftwiderstands-Untersuchungen an Automobil-Modellen, Z.F.M., July 31, 1922.

⁴ E. Rumpler, Das Auto im Luftstrom, Z.F.M., Heft 3 and 4, 1924.

⁵ Fifty miles per Gallon with Correct Streamlining. S.A.E. Jan., 1933.

⁶ Aerodynamic Characteristics of Automobile Bodies Bureau of Standards Journal of Research, Aug., 1933.

⁷ O. G. Tietjens and K. C. Ripley, Air Resistance of High Speed Trains and Interurban Cars. A.S.M.E. Applied Mechanics, Sept., 1932, and Railway Mechanical Engineer, Jan., 1932, page 18.

University⁸ gave a value for n of $-.09$ in free air, and $-.06$ in a test by the mirror method.

In tests at New York University⁹ on a model of a modern streamline train, the value of the exponent n in the formula

$$R = C \frac{\rho}{2} A v^2 \left(\frac{1}{\nu} \right)^n$$

was only $-.017$ showing that for even a streamline train, the effects of scale are very small. In tests of

dimensional curves of resistance to be practically parallel to the wind speed as the abscissa.

With unstreamlined automobiles, locomotives or trains it would appear to be quite safe to put $n = 0$. With well streamlined trains, test runs should be made at varying speeds as a check, but no serious errors will be made by assuming n also zero. The question of scale effect in wind tunnel tests of trains does not appear to have anything like the importance sometimes imputed to it.

No direct comparison between tunnel tests and full scale tests for complete train are as yet available. Comparisons for a single coach have been made by Vogelpohl¹¹ on the basis of his tunnel tests and full scale tests

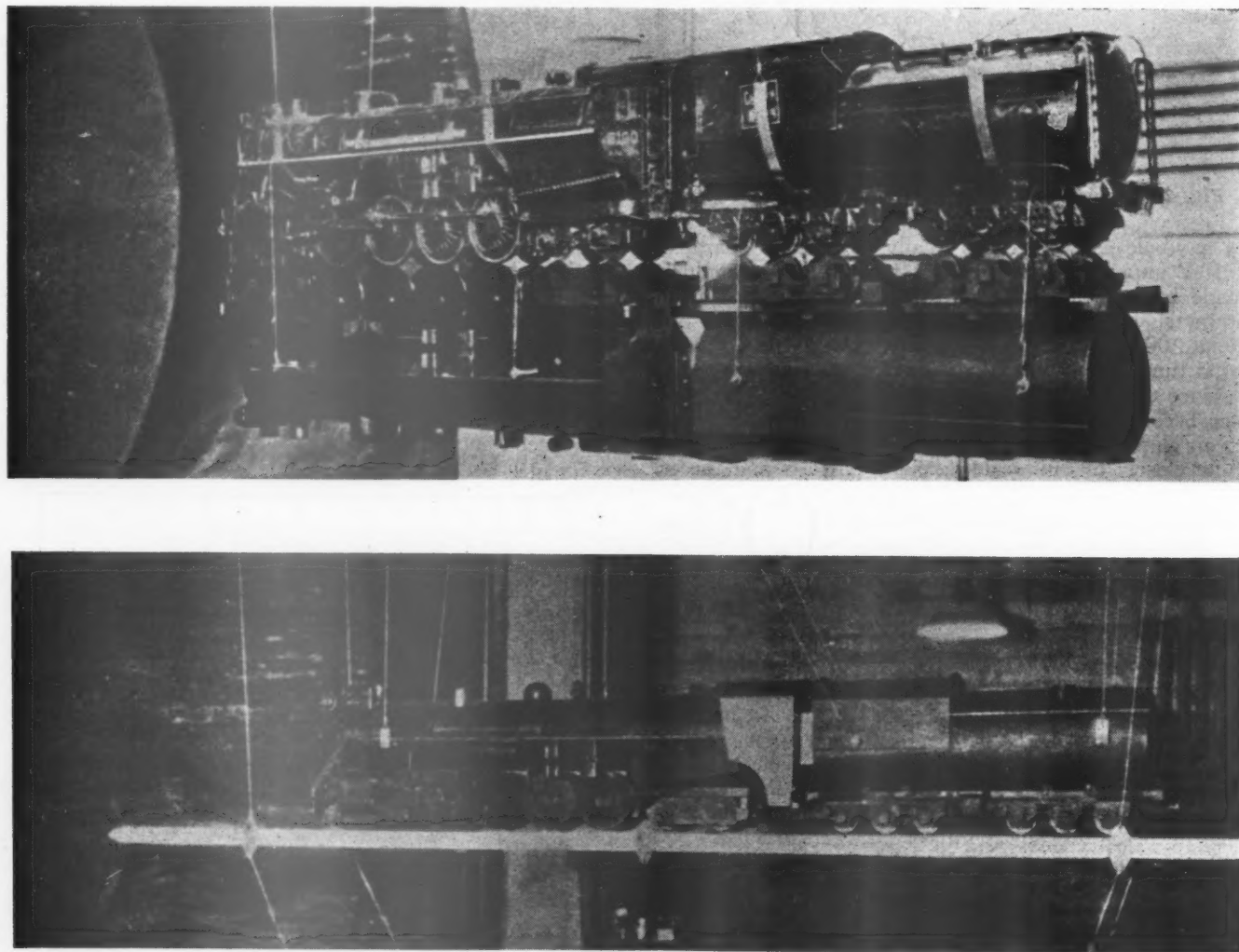


Fig. 4—Mirror and ground board tests for C. N. R. locomotive

a Jaray streamlined single car also at New York University n had a somewhat higher negative value, but the Jaray car had much more of the true airship type of form.

In experiments at the Berlin Technische Hochschule on a single unstreamlined railway coach, all the curves of the resistance coefficient plotted against wind speed tended towards asymptotic values. Typical values of n were as follows:

"Smooth" coach $-.07$
Coach with windows, ventilators, etc. $-.05$

Maurain¹⁰ in tests of a French train composed of a locomotive, tender, coach and box-car found his non-

by Nocon.¹² The "Smooth" tunnel model gave 15 per cent less resistance than the full scale model. A tunnel model equipped with windows, ventilators, etc., gave only 5 per cent less resistance than the full scale test. The concordance is gratifying.

Detail Construction of Models

Models should be as light as consistent with adequate strength, so as not to lessen the sensitivity of the balances. It should be possible to fasten models of separate coaches rigidly enough to obviate misalignment under

¹⁰ Ch. Maurain, *Resistance de l'Air Sur les trains, Recherches et Inventions*, Nov., 1923.

¹¹ G. Vogelpohl, *Luftwiderstand von Eisenbahn-Fahrzeugen*, Z.V.D.I., Feb. 3, 1934.

¹² E. Nocon *Glaser's Ann. Bd.* 108 (1931), P. 99.

* Unpublished.

* Unpublished report.

wind forces. Finish of models should of course be as smooth as possible. Well seasoned mahogany or maple are excellent woods for model construction, and will keep their form indefinitely. In building models for an experimental test program, expense and trouble will be saved by using detachable noses or tail pieces, etc. Plasticine may be readily employed for experimental fairing.

A more difficult question in model construction is the representation of detail. The train model as a whole may be well beyond the critical Reynolds' Number, but certain details whose linear dimensions are of course much smaller than those of the model as a whole, may in itself be below its own critical Reynolds' Number—as for example a projecting cylinder. Not only will small details of this sort have in themselves too great a resistance, but owing to the disturbed flow round them their interference with adjacent parts of the locomotive or train will be unduly severe.

Models should not be constructed to show too great detail. In airplane practice, when models of air-cooled engines are subjected to resistance tests, such details as overhead rocker arms and cooling fins are not reproduced. The cylinder is represented by extending its diameter to the outer dimensions of the cooling fins, and the head of the cylinder is simply rounded off.

Certain details may be removed and their resistance subsequently allowed for by calculation or independent test.

Common sense and aerodynamic experience should allow questions of detail reproduction to be settled. Where doubt exists, it is always possible to test cer-

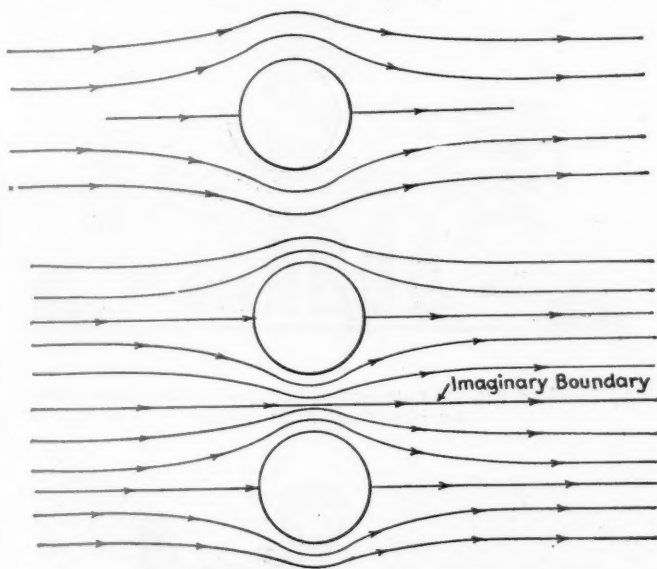


Fig. 5—(Above) Theoretical flow past a cylinder—(Below) Flow past two identical cylinders showing imaginary boundary

tain parts of the model to a much larger scale; and thus arrive at an estimate of the real effects of interference and scale effect on details.

The amount of detail in the model of the C. N. R. locomotive¹³ as tested at Ottawa is shown in Fig. 4. In Göttingen¹⁴ experiments on two high speed electric cars, door handles, window sills, and such details were omitted.

Theoretically the wheels of a train should be in circular motion when tests are made in the tunnel, since the resistance of a rolling cylinder is greater than that of a stationary one. No information is available, but the

¹³ loc. cit.

¹⁴ Ergebnisse der Aerodynamischen Versuchsanstalt zu Göttingen, III Lieferung, p. 162.

problem should not be one of more than secondary importance.

Ground Effects—The Mirror Method

When a train is in motion over the ground, the air at the nose is brought into motion by impact; that at the sides by adherence in the boundary layer. The effect of the train on air diminishes with the distance from the train, so that the actual surface at the ground should be of comparatively little importance. Further the projections of cross ties and roughness of gravel are small in relation to the other dimensions of the train.

In Fig. 5 is shown the theoretical flow past a cylinder. If as in Fig. 5 two identical cylinders are disposed then the flow is as represented and it is seen that no air flows past an imaginary boundary, parallel to the line of air flow, and placed half-way between them. Hence a "mirror" cylinder will simulate the presence of the ground. It is on this simple principle that the "mirror" method of wind tunnel testing for ground effect is based (as illustrated in Fig. 4).

Granted that the actual surface of the ground is of little importance, then ground effect on a train should be simulated by disposing two identical trains, one in upright position and one in inverted position, and in such fashion that the distance between two similar points is twice the distance of these points from the ground. The only aerodynamic objection to the mirror method is that vortices are produced periodically, and that vortices for the upright train and for the inverted train are not likely to be produced at exactly the same instant. Hence the mirror method is open to the objection that while the bodies tested mirror one another, the flows do not.

A more practical objection to the mirror method is that it involves additional expense in the duplication of models and in the additional time and effort in testing. Granted even that the mirror method is fairly sound theoretically, it would be an advantage to use some simpler method of test.

The Free-Air Method

In the free-air method the model is simply suspended in the tunnel without "mirror" or "ground board." This of course is the simplest of all methods.

The free-air method is open to obvious objections. The air is not constricted by the presence of the ground; the flow over the lower part of the train model is evidently faster than it should be; there are two unrestricted sources of vortex or eddy formation at the front portion of the train. Therefore, it may be expected that the free air resistance will be greater than is really the case.

Ground-Board Method

Another method of test is to introduce a ground board under the model to be tested, as shown in the lower portion of Fig. 4. This is open to the theoretical objection that owing to the formation of a boundary layer on the ground board, the air is slowed up below the train, and the resistance may be unduly decreased. Attempts have been made by Professor Lay to remove the boundary layer by application of suction to the under side of the ground board; but such attempts have not proved very effective.

Moving Belt Developed at New York University

The one method which is absolutely free from theoretical objection is the use of a moving belt placed under the body to be tested and moving at exactly the same speed as the air. Here the constriction of the ground is

present yet there is no retardation of the air flow by the presence of a boundary layer on the ground board. Such a method was assayed by Eiffel some twenty years ago, but failed owing to the flapping of the belt. Under the writer's direction the method was revived and with careful mechanical design and some cut-and-try experimentation proved entirely successful. The moving belt method is illustrated diagrammatically in the sketch of Fig. 6.

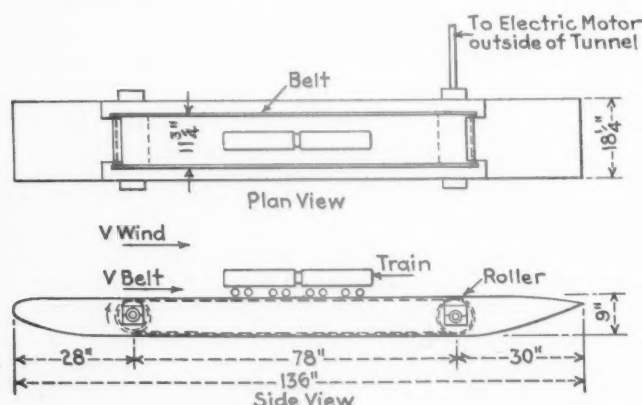


Fig. 6—Endless leather belt running on rollers at same speed as air in tunnel

Thanks are due for the encouragement and cooperation of the American Locomotive Company and the American Car & Foundry Company in this experimental work.

Comparisons of Various Methods of Tests

In the following table are given the representative drag values obtained with a model of a locomotive and tender, and a coach, in the form of a fairly well streamlined model, obtained at a wind speed of 60 miles per hour.

1—Mirror method .....	.49 lb. drag
2—Free Air .....	.55 lb. drag
3—Ground board .....	.38 lb. drag
4—Moving belt .....	.38 lb. drag

The concurrence between the ground board method and the moving belt was quite close at other speeds of tests, and the scale index n was the same for both methods. The free air always indicated the greatest resistance which is entirely in accordance with theoretical considerations. An exploration of the velocity in the presence of the ground board indicated moderate slowing up of the air flow and that only to the rear of the model.

From these tests, conducted with considerable care, the practical conclusion may be arrived at that simulation of the ground is essential. It may further be concluded that where a train model is near the ground and trucks impede the flow near the ground, the reduction in drag introduced by the retardation of the boundary layer of the ground is negligibly small.

This is a very important result for the technique of train testing in the wind tunnel. Since moving ground is now available it should always be preferable to test with a moving belt. But for comparative work the simple ground board method should be adequate.

Of course further experimentation will be necessary to verify the above conclusion, and for any new shape or varying length of train, comparison with the moving belt test should *always* be repeated.

For automobiles, the situation is entirely different. In automobiles the moving belt method is the only one that is thoroughly valid. To discuss ground effects in the automobile is however beyond the scope of this article.

[Part II will take up head-on air resistance for locomotives and trains.—Editor.]

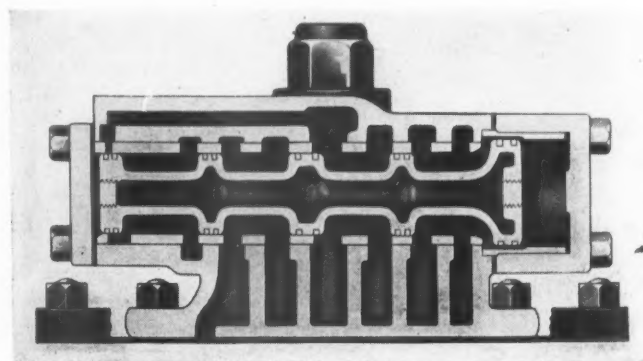
Top Head for Cross Compound Compressors

THAT the 8½-in. cross compound air compressor for air brake service may now be furnished with a new type of top head embodying improvements designed particularly for high temperature and high pressure steam conditions, yet none the less valuable for general use, is announced by the Westinghouse Air Brake Company.

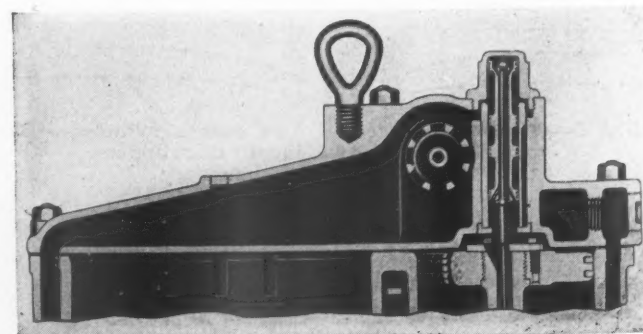
A reversing valve of the piston type replaces the slide valve type. The evils of high friction, intensified by higher steam pressures and temperatures are thereby eliminated. There is, therefore, less strain on the reversing valve rod, and, since reversing action is positive, better general all around compressor performance is obtained.

The main valve piston is now made in a single casting, instead of bolted segments, to insure maintenance of alignment. The four small pistons are of equal diameter and operate in a single bushing; the former small bushing in the cylinder cover is eliminated, and the large piston bushing is now in the cover. This improved construction simplifies assembly, fitting, and repairs and there is one less ring to stock.

The steam pipe connection can now be made directly to the top head, thus eliminating one of the most common head gasket troubles, i.e., leakage from the steam supply passage into the top end of the high-pressure cylinder.



Top head of 8½-in. cross-compound air compressor showing improved main piston



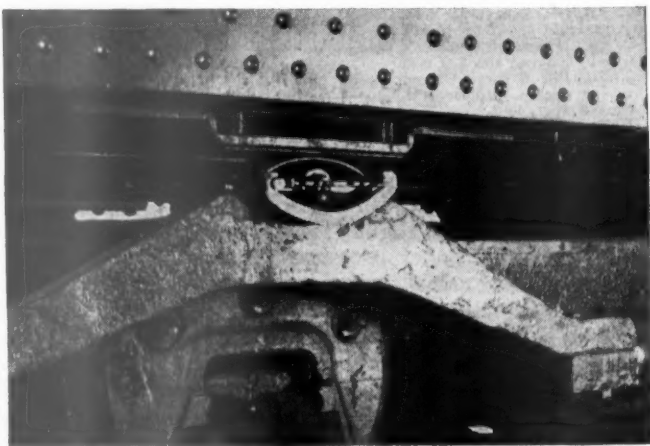
Top head of 8½-in. cross compound air compressor showing piston type reversing valve

With this arrangement the steam passage in the cylinder is separated from that of the top head by a plug, and the pipe connection for the former left open to avoid possibility of water freezing in the cylinder passage. The present method of connection may still be used, however, by a mere transfer of plugs.

Shock Absorbing Side Bearing

A NEW type of side bearing for passenger-train cars, developed and tested during the past two years by the Railway Products Company, 5949 Superior street, Chicago, is designed to include a shock-absorbing feature in its construction, as well as to provide a gradually increasing resistance to car roll under all conditions. It also promotes ease of truck swiveling, elimination of noise, and freedom from maintenance difficulties. The initial application of this side bearing was made to a steel dining car of the Chicago & North Western, on which it is reported to have given satisfactory service for a period of over 18 months, with frictional wear negligible and no adjustments, repairs, or replacements required.

This side bearing, which is called the RPCO (Drews) type, can be applied without any change in the construc-



Application of RPCO (Drews) shock-absorbing side bearing on a steel dining car of the Chicago & North Western

tion of car body or truck. It is simply bolted to the side bearing arch of the truck with two 1/2-in. bolts through an adapter plate which replaces the friction plate usually provided. The RPCO bearing, itself, comprises essentially a cast-steel base plate, which is capable of sliding movement at one end in a saddle casting to provide the small extension in length required when the supporting springs are compressed. These springs include an arched spring plate which bears against the car body side bearing and two truss springs located one on either side of the truck side bearing. In operation, when the car body rolls, the arched spring plate is flattened, slightly extending the length of the base plate, and, therefore, deflecting the truss springs. In other words, the movement of the car body in rolling is resisted by the combined spring action of the arched spring plate and the two truss springs, the motion being definitely stopped by a limit block cast on the base plate.

With this type of side bearing, clearance is unnecessary, and maximum flexibility is secured with the total elimination of noise and shock. Other advantages are the reduction of frictional area from 52 sq. in. for the standard bearing to one sq. in. maximum for the RPCO bearing, with consequent reduction in friction. Ease of assembling or dismantling is assured, also the avoidance of frequent side bearing adjustment and repair. Shocks usually transmitted from rail and rail joints through the body side bearing are absorbed and additional cushioning provided for truck and body parts. Should any part of the RPCO side-bearing break for any reason, the car would ride safely, as the limit block

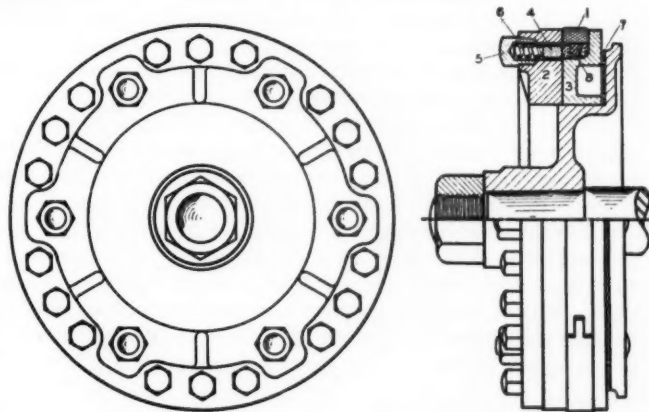
is the highest point in the assembly after the arched spring plate is removed, and the car would ride on the limit block.

The way this side bearing is designed to operate with a car on curves is as follows: When the car is nosing into a curve, the centrifugal force moves it over onto the side bearing, which is on the outside of the curve. This swings the car off the center line of the rails, due to the swing hanger arrangement of the truck, producing a greater load on this side of the truck (which is desirable) and thereby preventing the wheels on this side from climbing the rails. The flexible side bearing aids this condition by placing an additional load on this side of the truck until the car has reached the banked portion of rail when it aids in gently but flexibly moving the car body over towards the inside of the curve. When the car comes out of the curve, the side bearing aids in straightening out the car, and any shocks due to irregularities in the rail, rail joints, sticking journal boxes, eccentric or out-of-round wheels, etc., are flexibly cushioned on curves as well as on straight track.

King Cylinder Packing For Power Reverse Gears

THE packing ordinarily used in power reverse gears is of the molded cup form, the cup being composed of asbestos and rubber which is formed into shape and the rubber then vulcanized.

Some time ago the Interstate Commerce Commission issued an order to equip power reverse gears with steam connections. The object of this order was to secure added



King packing for reverse-gear cylinders

safety so that if there should be a broken air connection to the power reverse gear it could still be operated by steam to reverse the valve motion. By reversing the engine and closing the throttle the main cylinders of the locomotive would act as air compressors and the resistance thereby set up would in course of time bring the locomotive to a standstill. Since steam connections have been applied to power reverse gears, there have been a number of engine failures brought about by the emergency use of steam in these gears, which has the effect of disintegrating the molded rubber and asbestos cups.

To meet this situation the United States Metallic Packing Company, Philadelphia, Pa., designed the King cylinder packing shown herewith. Ordinarily no alterations are made in the piston head, but the existing

molded cups, bull ring and follower are removed and discarded. In their place is applied gasket 7, bull ring 3, and King cylinder packing ring 1. Three turns of soft fibrous packing are then applied in the cavity left between the King cylinder packing ring 1 and the bull ring 3. This fibrous packing is made of pure asbestos—no rubber enters into its composition—so that there is nothing to deteriorate from the effect or temperature of the steam. Follower 2, with expander 4 in place, is now fitted over the studs which held the former assembly in place, nuts are applied to the studs and drawn up tight. Springs 6 and caps 5 are inserted and pulled up tight. These springs exert a constant pressure on the fibrous packing and prevent leakage of pressure between parts 1 and 2, and between parts 1 and 3, and also provide a resilient body to support the King packing ring 1.

Bethlehem High-Speed Auxiliary Locomotive

A MODERN freight locomotive must be capable of developing a large horsepower at operating speeds in order to handle modern trains. Present requirements demand higher speeds as well as greater power. The need for larger boiler capacity is now generally recognized and a locomotive that can meet present demands has ample boiler capacity. The ability to make time on a fast schedule, however, depends not merely upon maintaining a high running speed, but also upon the ability to accelerate a heavy train to full speed in the shortest practical time. At starting and at the lower range of speeds the main cylinders of a locomotive can not, however, utilize the full steaming capacity of the boilers now provided. In order to utilize this surplus boiler capacity at low speeds and thereby add to the starting power and also increase the rate of acceleration, some auxiliary power means must be provided. These facts are by this time quite generally recognized and, consequently, such an auxiliary is properly becoming a fundamental part of any modern locomotive unit.

In order to make available an auxiliary locomotive capable of overcoming the inherent limitations of the conventional locomotive in the lower range of speeds as described and which, in addition, can be used in high-speed freight and passenger train service, a new type of auxiliary locomotive, Series H, has been designed, con-

structed and thoroughly tested by the Bethlehem Steel Company, Bethlehem, Pa. The illustrations will serve to show the general construction of the new design while a reference to the table will give a comparison between the Series H and the older Series A and S.

Compared to the older four-wheel Series A and the six-wheel Series S auxiliary locomotives, both having 36-in. wheels, the high-speed Series H machine with

General Data on Bethlehem Auxiliary Locomotives

Detail	Older Series A and S	High-Speed Series H
Cylinder diameter, in.	12	12 $\frac{1}{4}$
Piston stroke, in.	10	11
Gear teeth:		
a. Driving pinion	16	21
b. Axle gear	36	47
Gear ratio, 1 to	2.250	2.238
Diameter of drivers, in.	36	42
Piston data:		
a. Area, sq. in.	113.10	117.86
b. Displacement, cu. ft.	0.6545	0.7503
Revolutions per mile:		
a. Drivers	560.2	480.0
b. Crankshaft	1,260.50	1,074.24
At a train speed of 1 m.p.h.:		
a. Drivers, r.p.m.	9.34	8.0
b. Engine shaft, r.p.m.	21.01	17.90
c. Piston speed, ft. per min.	35.01	32.82
d. Piston displacement, cu. ft. per min.	27.50	26.86
Cut-off, per cent.	70	70
Cylinder tractive force at any train speed....	90.0p*	87.96p*

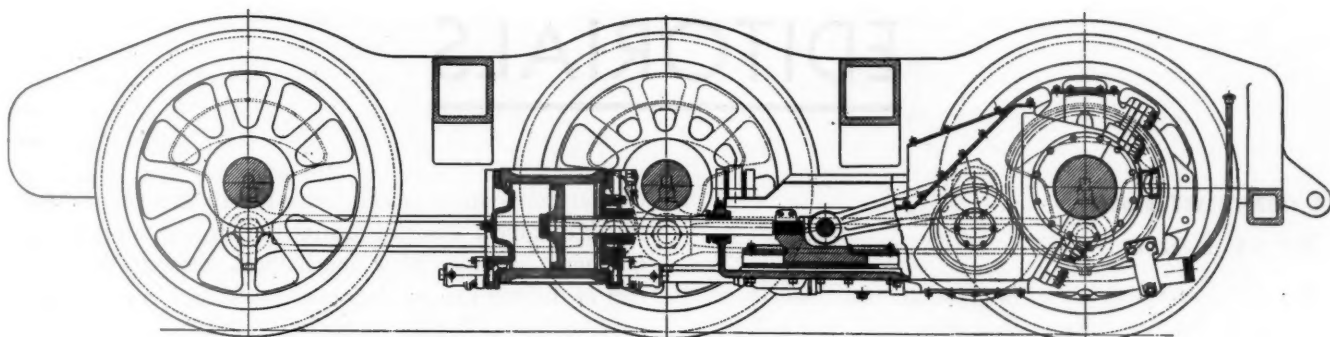
*p is mean effective pressure in lb. per sq. in.

42-in. wheels has slightly lower starting tractive force with the same boiler pressure and slightly greater tractive force beyond a speed of about eight miles an hour. Also, due to the larger wheel diameter and to a reduction in side-rod length from 80 to 60 in., the rod stresses of the Series H machine at any given high speed are slightly less than 50 per cent of the Series A and S machines. As a result of being so proportioned the Series H machine is capable of running at speeds of at least 100 m.p.h. without developing excessive stresses in the side rods or other parts of the truck.

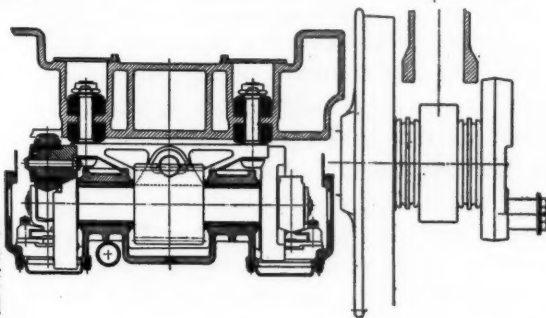
The Series H auxiliary locomotive is mounted on a Commonwealth, fully-equalized, six-wheel, cast-steel truck frame, with axles uniformly spaced on 60-in. centers. The wheels are 42 in. in diameter with heat-treated steel tires and S K F roller bearings are provided on all three axles. The brake gear is of the full-floating clasp-brake type. The engine is of the two-cylinder type with piston valves and cylinders 12 $\frac{1}{4}$ in. in diameter with 11-in. stroke and coupled to the driving axle at a gear ratio of 21 to 47.



Bethlehem high-speed auxiliary locomotive, Series H, applied to tender of Lehigh Valley 4-8-4 type freight locomotive



Sections of Bethlehem high-speed auxiliary locomotive, Series H, applied to a six-wheel truck



In order to provide the maximum of strength and durability special materials are used for many of the more important parts. For example, the engine frame is of manganese molybdenum cast steel specially heat-treated for high ductility and maximum strength. The side rods and side-rod cranks are nickel manganese steel, heat treated. The engine pinion shaft with integral driving pinion and cranks and other important details are of $3\frac{1}{2}$ per cent high-grade nickel steel, heat treated. Piston rods and valve stems are of stainless steel. Journal boxes and many castings are of electric-furnace steel.

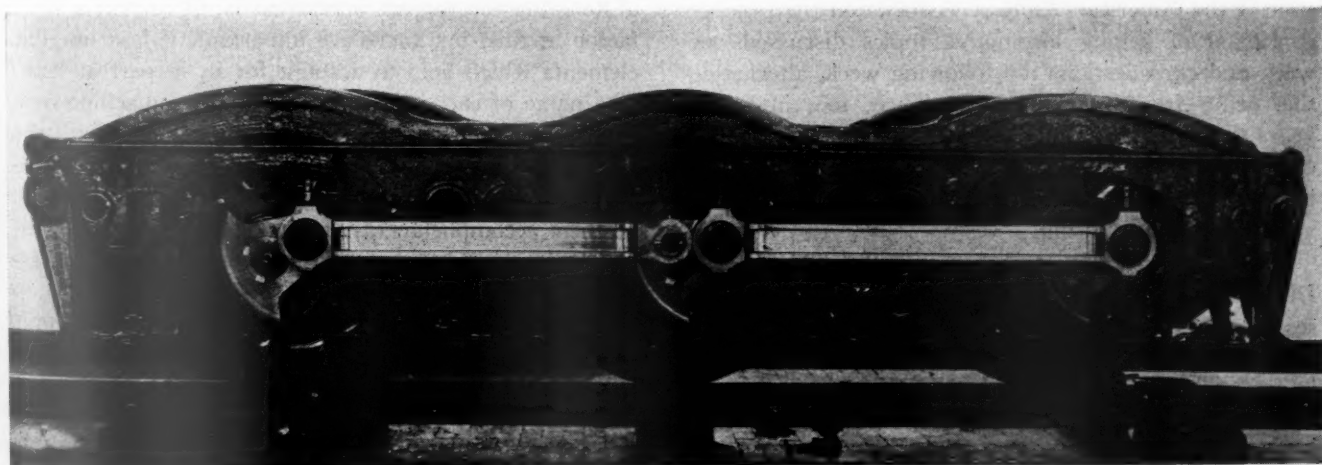
By the use of 42-in., instead of 36-in., wheels a greater maximum wheel load capacity is provided and the number of revolutions per mile is decreased. This, with the shorter rods, makes it possible to use the Series H auxiliary locomotive with any high-speed locomotive at the highest possible speeds. All parts come within the A.R.A. third-rail clearance lines. The design is suitable for application on either the front end or the rear end of the tender.

The auxiliary engine is operatively connected to the driving axle automatically when the auxiliary engine is cut-in and is disconnected automatically when the auxiliary engine is cut-out. The train speed at which the machine can be cut-in or cut-out is limited only by the inadvisability of operating it under steam at a speed beyond which it would not deliver sufficient additional drawbar pull to warrant its use. The control of the Series H auxiliary locomotive is provided for by the two

levers of the duplex control valve—one for steam supply and the other for the cylinder cocks. The duplex control valve is so interlocked with the reverse lever of the main locomotive that the auxiliary locomotive can not be cut-in unless the reverse lever is set for forward motion.

Bethlehem Series H high-speed auxiliary locomotives were applied to the tenders of ten 4-8-4 type locomotives built for the Lehigh Valley in the spring of 1932, for high-speed heavy freight service. These locomotives carried a boiler pressure of 250 lb., had cylinders 27 in. by 30 in. and 70-in. drivers. The rated cylinder tractive force of the locomotive itself was 66,400 lb. The tender weighed 398,330 lb. in working order and had a capacity for 20,000 gal. of water and 30 tons of coal. The auxiliary locomotive applied to the rear of the tender had a rated tractive force of 18,360 lb. Tests showed that at starting it added 17,570 lb. to the drawbar pull, 12,540 lb. at 10 m.p.h. and 6,720 lb. at 20 m.p.h.

The performance of these auxiliary locomotives has been excellent. A check of the tires on one truck after 20,000 miles of high-speed service showed less than $\frac{1}{16}$ in. tread wear which was uniform on all wheels. There was no perceptible wear on any of the flanges.



Side view of Bethlehem Series H high-speed auxiliary locomotive for six-wheel tender truck

EDITORIALS

Conventions Next Year

We have received some interesting reactions to the interview with a railway executive and the editorial comment relating to it, which appeared in our July number, suggesting a revival of the mechanical conventions. The General Committee of the Mechanical Division of the American Railway Association, at its meeting in June, voted to hold a full membership meeting in 1935. Nothing was said about an exhibit, since that is a matter which requires joint action by the Mechanical Division and the Railway Supply Manufacturers' Association. One of the reasons advanced for holding the convention next year, however, was that during the long interval between the conventions a sufficiently large number of new appliances, tools, equipment specialties, etc., had been developed to justify the special study and consideration of mechanical department officers. This would seem to infer that exhibits will be welcome if the railway supply manufacturers can see their way clear to co-operate.

The exhibits at the Atlantic City conventions have grown to enormous proportions. The manufacturers, however, have felt justified in going to the heavy expense involved, because under former conditions the exhibit extended over a period of seven or eight days and a large number of railway officers and foremen attended the conventions and visited the exhibits.

The extensive exhibit was made possible because in the early days it was the custom for the American Railway Master Mechanics' Association and the Master Car Builders' Association to schedule their meetings so that one of them would meet on Wednesday, Thursday and Friday of one week, and the other on the following Monday, Tuesday and Wednesday. When these two associations were combined into the Mechanical Division of the American Railway Association the practice continued of having locomotive topics discussed one week and car questions the following week, alternating this order from year to year. Then, too, in recent years the Purchases and Stores Division of the American Railway Association has met at Atlantic City for three days during the period that the mechanical conventions were in session.

The question now being asked is, will the Mechanical Division go back to the old practice of holding six sessions extending over an eight-day period, or will it try to confine its sessions to a shorter time? If so, there is a grave question as to whether the railway supply manufacturers will be warranted in going to the expense of setting up the exhibits for the shorter period. The suggestion has been advanced that some arrangement might be made to have the minor mechanical asso-

ciation conventions meet immediately before or after the Mechanical Division, using the same exhibit for all of them. These other mechanical associations have met at different times during the year and in most cases have had small highly specialized exhibits. A group of railway supply representatives suggested several years ago that it might be wise to hold all of the conventions at about the same time, thus making it possible to combine the exhibits and ease the burden on the supply companies. The depression, however, interfered with the working out and actual application of this scheme.

The suggestion now comes from several sources that the Mechanical Division and all the other mechanical associations get together and co-ordinate their programs and meetings, so that one large exhibit can be held for all of them. One objection to holding all the minor conventions at the same time is that too much of the supervision will be off the job. This might be partially overcome by holding some of the meetings in advance of the Mechanical Division meeting and some following it.

The Sayre Shops

The Lehigh Valley has been successful in applying the progressive spot system of locomotive repairs to its transverse type shop, the technical details being fully outlined in an article elsewhere in this issue. Only part of the story is told, however, since the article makes no reference to a rather intangible, but nevertheless extremely important, element in the success of the project—personnel relations.

One is impressed with the orderliness of the shop and the noticeable absence of confusion. The system of handling the various operations is, of course, a large factor in this, but there are important, if less tangible elements which help to account for it, in part at least. The name of each worker in charge of a machine or a job is prominently displayed, in the latter case with the designation of the class of work for which he is responsible. The workers naturally take a greater pride in their accomplishments, and undoubtedly this innovation does much to encourage higher ideals of craftsmanship.

Back of all this, however, is a still more important element. The employees have an organization to represent them known as the Maintenance of Equipment Association. Committeemen represent the different crafts in all departments throughout the plant and it has never been necessary to carry a grievance beyond the superintendent of motive power. Subsidiary to

this organization is the Sayre System Shop Athletic Organization, of which one of the workmen is president. It not only promotes athletic sports, but maintains a cafeteria in the assembly hall, and has done much to promote welfare work. The assembly hall is located in the shop plant, having been converted from one of the former shop buildings, and to a considerable extent is the center of community social activities. The Ladies' Auxiliary is largely responsible for this. It numbers about 2000 members and has provided clean entertainment for shop affairs, and has also stimulated a considerable amount of charitable work.

Technical methods, of course, have their place and cannot be minimized. A friendly family spirit, a pride in craftsmanship, cleanliness and orderliness are also essential factors in the successful operation of any organization.

Roller Bearings Go Marching On

The initial application of roller bearings to trucks of passenger-train cars in this country was made some twelve years ago. Today, in drawing up plans and specifications for new passenger-train equipment or for rail motor cars it is doubtful whether any road would neglect at least to consider the use of roller bearings and the probability is that such bearings would be specified as they have come to be considered a part of modern equipment, the additional cost of which is fully warranted in view of improved performances and reduced operating costs.

For freight-train service experimental installations have been made, but interchange and economic conditions have so far prevented their adoption for this class of service. However, in the last report of the A.R.A. Lubrication Committee the inadequacy of the present standard journal box with its brass, wedge and waste lubrication practice was pointed out and the committee was instructed to develop a program of test procedure with an estimate of probable costs in connection with an investigation of improved lubrication methods. While this did not mean roller bearings, it did indicate a feeling that something better than the present practice would have to be adopted in the future.

After the success of roller bearings in passenger-train service had been demonstrated, it was natural that their use should be extended to locomotive service, particularly as the lubrication of engine-truck journals had always been a source of more or less anxiety to engine-terminal forces. A few engine trucks were equipped with roller bearings some seven years ago and further application to trailer and to tender trucks followed soon after. At the present time a considerable number of such trucks have been equipped and are reported to be giving good service. In 1930 roller bearings were applied to driving axles and a number of

locomotives are now so equipped. Some 75 electric locomotives have also been equipped with roller bearings on all axles. The next step forward was the application of roller bearings to main and side rods. Some interesting problems in design and in counterbalancing were encountered, but operation in heavy passenger service would indicate that there are no inherent difficulties. Thus another important step forward has been made.

Roller bearings have also been applied to many boosters and auxiliary locomotives. Another point where the use of roller bearings appears to be desirable is in valve-motion work. Thus far applications have been limited to transverse levers of valve gears for three-cylinder locomotives, but it is anticipated that they will soon be applied at other valve-gear points. Roller bearings have been of material service in increasing locomotive availability in hard service and on long runs. At whatever point they have been applied wear has been practically eliminated and but little attention to lubrication, adjustment or maintenance has been required—in short, roller bearings assure a long trouble-free life. The importance of extending their use has been recognized and this is very properly one of the subjects assigned to the A.R.A. Research Committee for investigation. A report is looked forward to with much interest.

Stand on Your Feet And Get Your Message Over!

The late C. H. Markham, of the Illinois Central, was widely and favorably known as a public speaker of force and ability. And yet, there are friends of Mr. Markham who can recall when in his earlier career he was more or less a failure in this respect.

There was a time when railroad officers did not appear much in public; today, the ability to speak effectively before an audience is a necessary part of their equipment—or should be. This is true not only of the executives and department heads, but is becoming increasingly important for supervisors and foremen, and is frequently a valuable asset for the man in the ranks.

An operating officer of prominence, when asked what was the most important thing that he had received in his four years at college, replied, "Membership in the literary society, because of the experience and training I received in public speaking." As a railroad officer he has consistently encouraged and helped his subordinates to learn to speak to an audience—and undoubtedly in some instances, at least, it has been a considerable factor in their advancement to more important positions.

The general manager of another railroad, impressed with the necessity of cultivating ability as a public speaker, encouraged a number of his associates to join with him to form a class. They retained an expert

to coach and instruct them; excellent results followed.

These thoughts are suggested by the interview with a public relations officer which appears on another page. The very existence of the railroads is at stake, unless the public can be fully aroused to the necessity of fostering them in the public interest. As pointed out in the interview, mechanical department officers and employees have a large opportunity and responsibility in this matter. Frequent opportunities for addressing groups of all sorts will open up to the man who is competent to speak to such audiences.

The ability to address an audience effectively is also a large asset on the job itself. An officer or foreman should be able to stand on his feet and make his points clear and convincing, in dealing with his associates and higher officers, as well as with his subordinates. Incidentally, also, the effectiveness of railroad associations and clubs would be greatly enhanced if the members took the matter of public speaking more seriously. It is almost pathetic to sit in even a small meeting of picked members of the mechanical department and try to follow men who are discussing problems of prime importance, but who can only be heard by those fortunate enough to sit within a few feet of them. The progress and achievements of associations have suffered seriously from these deficiencies in the past.

The American Society of Mechanical Engineers, realizing that important sessions of its annual meeting were suffering greatly because of inexperience of speakers in addressing even small audiences, retains a public speaking expert to come one-half hour each day before its sessions open, to make practical suggestions to the speakers as to how they can get their messages over more effectively. Engineering societies are bringing pressure on engineering colleges to make English and public speaking mandatory in their courses.

How can a railroad man get instruction and training in public speaking? In many cities and towns the public school system, the Y. M. C. A., or some other organization sponsors such courses. There are excellent books on the subject which can be studied with profit. The important thing to do is what many men have done with success—join some club, or group, or organization, where you can get practice, for, after all, that is of first importance, particularly if one is willing to discover a few simple rules and attempt to apply them.

The public relations officer interviewed spoke enthusiastically of supervisors' clubs on his road, which have proved most helpful in developing speakers who have given a splendid account of themselves, both within the organization and also in dealing with the public. Some of the supervisors' and foremen's clubs have fallen by the wayside in recent years. Some have come through with flying colors in spite of almost insuperable handicaps. More power to them! Let us hope, also, that with the larger demands and responsibilities upon mechanical department officers and foremen, new clubs will spring up which will give oppor-

tunity for training and practice in speaking to an audience. Indeed, these clubs could well afford to give specific attention to the problem of encouraging their members to take part in the discussions, with the deliberate intention of training themselves in public speaking.

Another Step in Locomotive Repair Methods

To many who have not been in intimate contact with the work of locomotive repair shops it might seem that the methods for performing this work have not undergone very much change in recent years. A brief review of what has actually transpired will show that the railroad shop has actually taken advantage of many practices that have been successful in other industries.

One need not look back so many years when labor was considerably less expensive and the pressure of demand for shop output was less severe to find that the problem of repairing a locomotive was principally that of placing it in a fixed location in the shop and removing, repairing and re-applying its parts without much thought being given as to the actual time the locomotive need be returned to service. As labor became more expensive and as traffic increased, pressure was gradually put on the shop to find not only more economical practices but those which would assure a substantial reduction in the number of days required by the shop to overhaul a locomotive. Then, too, the size of motive power was rapidly increasing and this complicated the problem of repair work.

In other industries, notably electrical-equipment and automotive, there came into being what has since been popularly called "production methods" and because of the outstanding success of such methods in those industries the railroads gradually became the target of those industrial modernists who thought that what was good medicine for manufacturing industries should be equally good for the railroad shop regardless of the fact that one is manufacturing and the other repairing.

Undoubtedly the credit for the initiation of the so-called "straight-line" method belongs to the automotive industry but the railroads can take some credit for the fact that they have studied these methods and have been successful in adapting them to the repair shop—a problem much more difficult because of its uncertainties.

Straight-line methods were first introduced into the railroad field in freight car building and repair work. In spite of initial opposition the system proved its worth in the car department and then was expanded by several roads into the locomotive shop in cases where it could be adapted to a longitudinal shop. Now two roads have bent the straight line a little and applied the system to transverse shops. From observation of these two installations there are many indications that an interesting experiment may develop into a forward step in a new direction.

With the Car Foremen and Inspectors

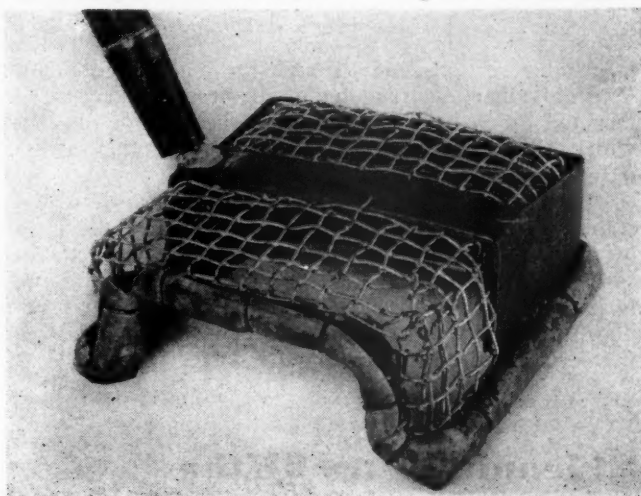
Rivet-Head Catcher

A RIVET-HEAD catcher, designed and made at the Milwaukee (Wis.) passenger-car shops of the Chicago, Milwaukee, St. Paul & Pacific, is now used instead of a broom, etc., to prevent rivet heads from flying when being cut off from the steel plates of passenger cars. This rivet-head catcher possesses several advantages: (1) The device stops the rivet heads at all times. With brooms, the bristles in time are cut off and rivets sometimes go through them. In an experiment the heads from $\frac{1}{2}$ -in. rivets were caught and held in the trap until 36 had accumulated without one escaping. The rivet-head catcher is, therefore, a safety device. (2) The device gives clear vision to both the rivet-buster operator and his helper who holds the catcher. It is impossible to see a rivet below a broom. By being able to see the rivet head, the gun operator will not hit the corner of it, or miss hitting it entirely as is often done when a broom is used. The device, therefore, speeds up production. (3) It is estimated that rivet choppers formerly used at least one new broom per week which costs $37\frac{1}{2}$ cents. The rivet-head catcher, being sturdily built at a small cost, will last for a considerable time. The device, therefore, is economical and a money-saver.

The device consists of a wire trap and a wooden handle. the trap is 8 in. long by 8 in. high, and is made of 2 by 2 No. 11 wire. The bottom frame consists of a $\frac{5}{16}$ -in. common iron rod. The bottom of the trap is entirely open so that it can be placed over the rivet heads that are to be chopped off. At one end of the trap, there is an opening 5 in. wide by 2 in. deep, through which the rivet buster can be inserted. The other end of the trap is reinforced by a $2\frac{1}{4}$ -in. No. 14 iron shield which extends half way around the sides of the trap for the pur-

pose of preventing the wire from being bulged when hit by chopped-off rivet heads. One of the illustrations shows that a large part of the trap consists only of wire, thus affording a clear vision of the rivets being cut off.

The wooden handle is screwed onto the trap by means of a $\frac{1}{4}$ -in. by 3-in. lag screw, the head of which is welded onto a No. 10 iron strap which extends over the top of the trap, and is welded onto the bottom frame rod. The wooden handle is 1 in. in diameter by 36 in. long, with a ferrule on the bottom. The handle is set so that it stands at an angle of about 45 deg. to the car surface,



A convenient and efficient rivet-head catcher

thus permitting the helper who holds the rivet-head catcher to keep out of the way of the rivet-buster operator and affording him freedom to work, and plenty of light.

The bottom edges of the trap are covered by rubber so that rivets can be removed when desired without the catcher scratching the paint and varnish on the steel sheets. The rubber is $\frac{1}{2}$ -in. white tubing, cut open at the center and cut at 45-deg angles at the corners for snug fits. The rubber is wired onto the bottom frame, the wire being drawn tight so that it is slightly embedded into the rubber.

Sash Buggy

IN order to handle passenger-car sash through the shops in an efficient manner, a number of sash buggies have been constructed and installed at the Chicago car shops of the Chicago & North Western, as shown in the illustration. Each buggy has a capacity to hold one complete set of car sash, the two center sections being adjustable to the various widths necessary. These adjustable sections, which are supported on ball-bearing rolls resting on the top of the welded angle-iron framework, are locked in any desired location by $\frac{1}{4}$ -in. rods which pass through holes drilled in the frames of the



Method of using the rivet-head catcher



Adjustable buggy which saves labor in handling passenger-car sash

adjustable sections and through the main buggy frame. The galvanized, corrugated sash supports are so constructed as to have the minimum bearing on the sash, which allows the sash to be delivered to the car with only a small marked surface.

The buggies are equipped with drawbars, as illustrated, so that several buggies can be pulled in a train by the shop tractor. The use of these buggies expedites sash movement and avoids the necessity of maintaining large stationary racks in the car paint shop, thus saving floor space, as well as greatly reducing the manual labor formerly required in handling passenger-car sash.

Cleaning Cars by the Scrubbing Method*

By C. S. Tompkins

IF all the methods of cleaning box and refrigerator cars, scrubbing is the most efficient and economical. The equipment needed is simple and inexpensive and the material and labor costs per car are low. In cleaning car floors, it is found that some oils are much more penetrating than others, depending, of course, on viscosity and gravity. A light paraffin oil is much more penetrating than a heavy cylinder oil, and, therefore, the cylinder oil is more easily removed.

In the case of materials such as hides, fertilizer, cabbage, fish, etc., which not only soil but produce odors of decomposition, the scrubbing method mechanically removes refuse matter, and the chemical action destroys the bacteria.

The Materials To Be Used

In selecting the materials to be used, there are but five alkalis that will function, caustic soda, soda ash, silicates of soda, tri-sodium phosphate and bicarbonate of soda. These may be used singly or two or more in combination. Caustic soda, when used alone, has proved injurious to the wood in floors in that it takes the life out of the wood, raises the grain and leaves a reddish tinge. It also is a hazard because of the burns so often

* This article is a part of a general treatise on box- and refrigerator-car cleaning prepared by C. S. Tompkins, a representative of the industrial department of the J. B. Ford Company, Wyandotte, Mich. The study presents facts developed as a result of several years' intensive experience with practical freight-car cleaning operations and methods.

suffered by the workmen. It is not the purpose of this paper to recommend any one alkali or any combination of alkalis sold under a trade name, but rather to explain a method for you to select the best yourself. The test that will prove this is simple and does not require the service of a chemist or technical training.

Suppose you want to find out the comparative emulsifying value of caustic soda and soda ash, or of caustic soda and some combination of alkalis, the method of testing comparatively is this: Make up a pint of each of the solutions to be tested at the same strength—say 6 ounces per gal. Heat them both to the same temperature, about 200 deg. F. Prepare some small pieces of metal about one in. sq., or take some iron washers and attach wires to them so that they may be hung in the solution. First dip these pieces into some mineral oil such as oil of petrolatum, cylinder oil, quenching oil, paraffin oil. Allow the two pieces to drain off and then place one in each of the solutions you have made and allow to remain for one minute. Remove and rinse in cold water. If the oil has been removed in the one minute the water will flow over the surface of the metal without a break, but if the oil has not been removed, the water will break over the oil not removed. If the two solutions both clean the metal, then add the same amount of oil to each solution, for instance two cubic centimeters, or five drops. Repeat the cleaning operation by dipping two more pieces of metal into the oil and then placing them in the cleaning solution for one minute and rinsing in cold water to determine if they are clean. Add more oil to each solution, the same amount to each. Continue to repeat the operations until one of the solutions fails to clean. Continue with the one that does clean until it fails, and the difference will be the comparative emulsification value. Suppose that one stops cleaning after twenty drops of oil have been added to the solution, and the other one stops at eighty drops. The emulsifying value of the latter is four times as great as the former.

Or suppose that when you start the test, one cleans and the other one doesn't. You have a pint of each solution at six ounces per gal. Add a pint of water to the one that does clean which will reduce it to three ounces per gal. Try it out at this strength and if it cleans, add another pint of water which will reduce it to two ounces per gal. Try it at this strength and if it cleans, you will know that it will do three times the work of the one that failed. Of course, the temperature should always be the same, about 200 deg. F. in all the tests. The idea is to determine which alkali or combination of alkalis will do the most cleaning at the lowest cost.

Equipment To Be Used in Applying the Materials

The equipment consists of a brush with handle, squeegee, sprinkling can, hose, hook for cleaning cracks, water pail, corn broom and spot hose nozzle.

Either a fibre or wire brush is used. If fibre, it should be of African Bass Fibre such as is used in street brooms. The fibre is stapled in a wooden block about 16 in. by 3¼ in. and gives a scrubbing surface of 18 in. by 5½ in. Two holes in the block provide for handle set at a 45 deg. angle. The wire brushes come in about the same sizes but care should be used in selecting the kind of wire. If the wire is too small in gage and not properly tempered, it catches in the cracks and splinters in the floor and becomes bent, thereby decreasing the scrubbing area of the brush.

A steel frame floor squeegee, with a provision for replacement of rubbers, is the most economical for removing excess water from the floor after rinsing. The

steel back is rigid so that by turning it over, it becomes a scraper. Rubbers should be about $2\frac{1}{2}$ in. wide and $\frac{5}{16}$ in. thick and come in lengths from 15 in. to 36 in. The frame is equipped to hold a $4\frac{1}{2}$ ft. handle set at an angle of about 45 deg. These squeegees are better and last much longer than where the rubber is mounted in wood.

A common garden variety of sprinkling can should be used to apply the cleaning solution—three to five gallon capacity. Holes in the spout should be enlarged to about $\frac{1}{8}$ in. to allow a free flow of solution and prevent clogging.

The hose is for rinsing out the car after scrubbing with water under pressure. The water may be piped along the cleaning tracks with openings for hose connections about every 40 ft. This allows for 100 ft. of hose to reach six cars without changing connections and reduces dead time.

A small hook is used, about 6 in. long with a round handle to fit the index finger or palm of the hand to prevent hook from slipping when the hands are wet, with the end having a $\frac{1}{4}$ -in. offset flattened to $\frac{1}{16}$ in. in thickness which is ideal for removing deposits of dirt from all cracks. It also may be made after the fashion of a long stove poker so that the worker may use it standing up.

A common heavy corn broom can be used for the removal of all loose dirt and refuse from the car. The hose nozzle should be the type with one handle that will permit turning the water on or off with one turn.

While not absolutely necessary, better and quicker results can be obtained when hot water is used to make the cleaning solution and for rinsing cars after cleaning. If hot water is not available, it is not difficult or expensive to secure it.

Some roads use old oil drums with the heads removed to heat water for the cleaning solution. These drums are placed every five or six car lengths along the cleaning track and are raised on a few bricks or old angle irons to permit space for a fire underneath. Old lumber from the repair track is frequently used for fuel. An old piece of sheet iron may be set up on the side to act as a wind shield. Often steel tanks of 50- to 100-gal. capacity are supported on legs leaving sufficient space for a fire underneath. Where steam is available a line may be run to an old oil drum and a pipe with open end can be used to heat the water.

The most efficient method of heating water where car

cleaning is done on a large scale is to have a hot water circulating system. In such systems water is heated in a tank and conveyed in an insulated pipe along the cleaning track. Hose connections are placed at intervals along the insulated pipe and hot water at about 200 deg. F. is available in each car. This system was described fully in an illustrated article in the May, 1932, issue of *Railway Mechanical Engineer*.

Method of Cleaning Dirty as well as Oily Floors

First, all loose dirt and rubbish should be swept out and nails and cleats removed. The hot cleaning solution should be placed in the sprinkling can and sprinkled evenly all over the floor to be cleaned. The workmen should then remove the accumulation of grain dirt and dust from all cracks and crevices thoroughly, using the hook. In this manner the cleaning solution is allowed to penetrate into these recesses and also to wet the dust and dirt so that if there are any grain weevils or insects in these corners, the cleaning solution will kill them at once. Another method of cleaning out dirt and dust from cracks and crevices is to attach a hose to the air line and with a small opening in the nozzle blow out before wetting the floor with the cleaning solution. However, some places will be found where the dust has hardened into the cracks so that the air won't release it, so as a rule the first method is better.

Scrub the floor, first crosswise of the floor boards and then lengthwise so that the bristles of the brush will penetrate between the cracks on the last time over. The amount of cleaner required and the time used in scrubbing depend, of course, upon the condition of the floor. In extremely oily cases, it is sometimes necessary to scrub twice. Conditions are sometimes so bad that it is necessary to cover the floor with the cleaning solution, then sprinkle sawdust about an inch thick over all the floor, wet this with the hot cleaning solution to about the consistency of mush and allow it to remain overnight, then scrub out in the usual way.

Rinse with water under pressure until the water runs clear, after which floor should be squeegeed to remove excess water so that the floor will dry quickly.

Roads using this method have found it difficult to state any positive strength of solution for all cleaning, but in the course of time this works itself out and car cleaners can almost at a first glance of car floor judge about what amount of cleaner is required to do the work economically.



The overhead insulated pipe line through which hot water is delivered to cars being scrubbed



The scrubbing equipment, including water hose and nozzle, scrubbing brush, sprinkling can, rubber squeegee and barrel containing the cleaning agent

If the floor is very oily and especially if the oil is of a thin nature that will penetrate deep into the wood, and you are skeptical as to whether the oil will show up again, a simple test is to heat some sand in the blacksmith's forge or in any other convenient manner, place the sand in a clean bag and lay it over the oil spot cleaned. Allow the bag to remain an hour or so and if there is oil left in the wood, it will show up on the sack. Or a common electric iron, heated and placed on a piece of blotting paper laid on the spot, will show up any oil left in the wood.

I might mention that in rinsing the car the sides and top should be rinsed also to remove any lime, grain or cement dust and insure a good clean and dustless car.

Deodorizing

In cases of hides, fertilizer, cabbage, fish and other soiling agents which leave an objectionable odor, one of the most important things in cleaning is to dig out between the cracks in the flooring and corners where any refuse may lodge so that the cleaning solution will have an opportunity to do its work. It is sometimes necessary after the first scrubbing to inspect these cracks and corners, and if they are not clean, to scrub a second time or even the third time before all the soiling agent is removed. In most instances if the car is cleaned thoroughly, there will be no necessity of using any other deodorant, but if there is still any odor, care should be used in selecting a deodorizer not to use a counter irritant. By that I mean one which has an odor of its own so strong that it predominates over the one we seek to eliminate. One of the most efficient deodorizers found so far is one with a content of chloramine gas available. This is much more effective than common chloride of lime or hypochloride gas, for the reason that in the former it may be used hot up to 180 deg. F. without

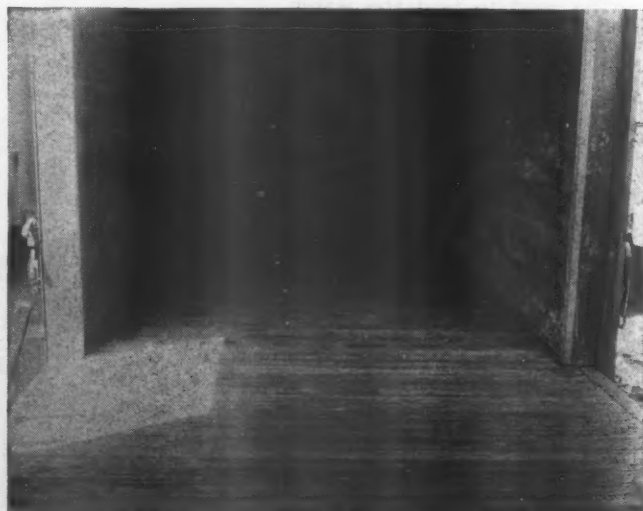
losing its power whereas in the latter, if used hot, the gas escapes from the solution. The chloramine agent is a good sterilizer also and will not oxidize metal while the hypochloride is a fast oxidizing agent.

Weevils

During the past year or so we have had to face the problem of getting rid of weevils caused by the shipping of corn and other grain that has been in storage for some time. Nine out of ten cars loaded with stored grain are infested with these bugs. We have experimented with gases of different kinds and have attempted to seal the cars by pasting paper over the doors and cracks. Sometimes, after leaving the car for a period of 12 hours and over, we have opened it up and found the bugs still there as lively as ever. The best method found to exterminate them is the use of a strong alkali, preferably a fusion of caustic soda and soda ash which makes a more active agent than straight caustic soda. This should be made up about 10 or 12 ounces per gal. and used as hot as possible. After the car has been scrubbed out as previously described, rinsed thoroughly, and the excess water squeegeed out, apply the hot alkaline solution. If corner cleats with three-quarter round or three-cornered are found in the ends of the car, they should be removed before scrubbing as these weevils are sometimes *hiding* there.

A good method of applying the hot alkaline solution is to use a 4- or 5-gal. capacity compressed-air sprayer equipped with a heavy carrying strap after the fashion of some fire extinguishers. The nozzle is equipped with a thumb valve and should be set to allow a stream about the size of a pencil lead. With the sprayer carried by the strap over the shoulder the operator directs this small stream into the cracks around the edges of the floors and sills. Car should then be allowed to dry without rinsing.

Many shippers of grain and food products are inspecting cars closely now, and if one of these bugs is found, the car is rejected. These inspections are conducted with a flashlight. The inspectors dig into every crack and bring out the accumulated dirt and dust in their hunt for bugs, so I repeat that one corner or crack missed in the cleaning operation may mean a rejected car and added switching charges.



Interior of double-sheathed box car after being thoroughly cleaned by the scrubbing method

Bugs of the weevil family are protected by a chitin or coating which is composed of a substance called glu-

coamine with calcium carbonate as the hardening agent. The body of the bug is divided into six segments, each of which is a respiratory tract. The action of the alkali in killing them is a chemical action in that it reduces this chitin or coating to a gelatinous substance and in so doing closes the pores in these respiratory tracts and actually smothers the bug. They do not come to life again, either. We have had some interesting experiences with them. We would try out a method of ridding a car of them and think we had accomplished our purpose only to find that the darned things were only playing possum and in a short time would come to life again.

The hotter the solution used to exterminate, the better, as a temperature of over 150 deg. F. is fatal. I might add that gas is very effective in exterminating pests such as cockroaches, bedbugs, water bugs, etc., but is a failure on weevils. One thing, of course, is evident about box cars—it is almost impossible to seal them air tight. However, in fumigating work cars, they can be sealed tight enough to rid them of bugs of the cockroach family.

Double-sheathed cars, when infested with weevils, are much more difficult to clean than single-sheathed cars. In treating cars the most important thing is to clean out the cracks and crevices of all accumulations of grain, dust and dirt, one corner or crevice not dug out may mean the rejection of the car for food products.

Now for a report on the cost of cleaning oily and greasy cars by the scrubbing method. This report covers a period of six months for cleaning 2,950 cars on one railroad, taking into consideration the complete cost per car. Of the total number of cars washed 20 per cent were carded to the repair track for cleaning, no other repairs being needed. All cars had the entire floors covered with various vegetable and mineral oils, they having been loaded with hides, fleshings, fertilizer, cement, lime, etc., which condemned the cars for high class ladings.

A careful analysis of all elements of cost, over a six-months period, shows an average of \$.9229 per car. This cost does not cover cars that were just swept out or cars that were simply rinsed out with water, but cars in which the floors were covered with grease, oil or other soiling agents as noted.

Refrigerator Cars

The general run of refrigerator cars usually require cleaning after each trip in order to insure a clean and odorless car. Cleaning mixtures are made according to the condition of the car, and are best known by those who handle this work daily. The general practice when opening doors is to remove all rubbish on top of the floor racks and sweep them clean. Then lift the racks into position and lock. Examine the ice pan racks to see that they are open, and proceed, sweeping the ice bunker and ice pan clean of all cinders, etc. Then sweep the floor. The cleaning solution is then sprinkled over the floor and on the ice pan when dirty conditions exist. Otherwise, after sweeping out the car, the floor racks are dropped and the cleaning solution sprinkled on the floor racks, floor and ice pans. The floor racks are then scrubbed and flushed off with a small amount of water, after which they are lifted into position and locked. The floor and ice pans are then scrubbed, flushed and squeegeed out. This procedure, of course, varies according to the condition of the car. A test made on a refrigerator car loaded with cabbage in a decayed condition showed a cost of cleaning as follows: Cleaner, .30; labor, .56; water, .01; electric energy, .03; overhead, .27; total cost, \$1.17. This was an exceptionally dirty car. However, the cost on other cars which are the

average run between 30 cents and 62 cents per car.

The intent of this paper, as before stated, has not been to advertise any product nor to criticize any method or materials used, but to give you the writer's experience and to get the subject before you so that by discussion and constructive thought the problem of furnishing a clean car to the shipper who rightfully demands one may be met at the least cost and with the greatest despatch.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Deposit of Mud in Tank Car after Test

The Great Northern tested a tank car belonging to the North American Car Corporation at their Great Falls shop and then returned it to the White Eagle Oil Corporation who found it necessary to steam tank and clean the interior with kerosene account of dirt and mud alleged to have been left in the tank when tested by the Great Northern. In addition to the White Eagle Oil Corporation repair card, joint inspection was secured showing that two inches of mud had been left in the bottom of the car. The North American Car Corporation claimed the Great Northern should assume responsibility for cleaning and deposit of mud. The Great Northern claimed that they used filtered water when tank was tested and no mud was present at that time. Failing to agree, the matter was referred to the Arbitration Committee. The North American Car Corporation contended that the car referred to was not loaded between the time it was tested by the G. N. and its receipt by the White Eagle Oil Corporation and that the residue, therefore, could not have got into the tank between the date of test and inspection. For some time prior to the test the car had been running in clean service carrying gasoline; had there been any existing deposit this would have caused the gasoline to go off color, with resultant claim against carrier for loss of value. That no such claim had been made prior to the time that car was tested is clear proof that the mud was carried into the car at the time test was made. Cleaning was necessary before the car could be used for transporting gasoline and, therefore, the G. N. should assume cost of subsequent cleaning, which amounts to \$7.58. The G. N. contended that water used to fill the tank for testing was filtered through a sand bed and was the same as used in their stationary and locomotive boilers. Such a deposit of mud it is claimed could not, therefore, have been introduced with the water used for test. During the past year more than 120 tank cars had been given hydrostatic tests at the same point, Great Falls, and no similar deposit had been reported.

In a decision rendered October 26, 1933, the Arbitration Committee said: "The evidence indicates that the responsibility for the deposit of mud in the tank car rests with the Great Northern. Claim of car owners is sustained."—Case No. 1730, North American Car Corp. vs. Great Northern.

In the Back Shop and Enginehouse

Engine-Condition Board

A CONVENIENT method of telling at a glance the condition of locomotives assigned to the various operating divisions of the railroad has been devised by W. H. Sagstetter, assistant superintendent of motive power of the Wabash. This is called a condition-of-engines board, and a plan of the one used in the motive-power office of the Wabash is shown. The object of this board is to have a complete and always up-to-date picture of the power situation, readable at a glance and without having to consult the various divisional typewritten statements of engine serviceability.

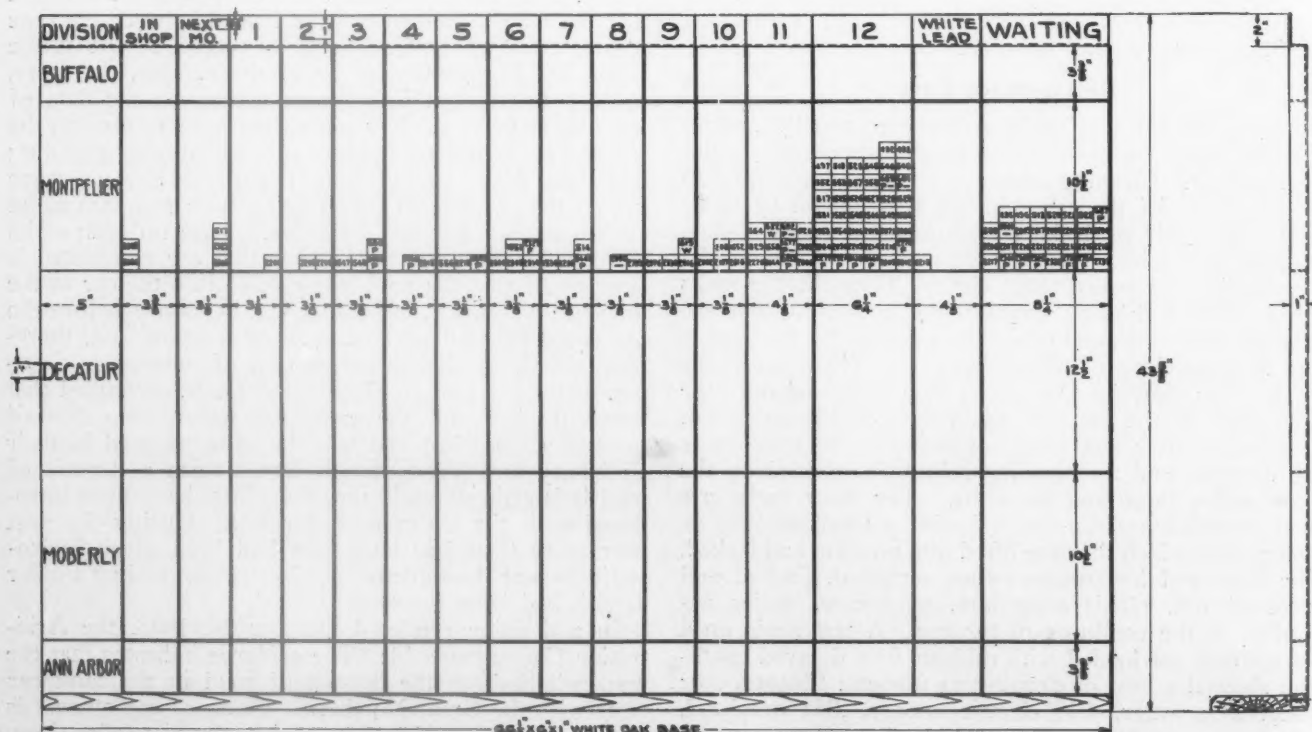
This board can be set on a desk or hung on the wall in the motive-power office, easily accessible to those interested. It is made of No. 16 gage iron with an oak stain finish and has transverse partitions separating the operating divisions, and vertical partitions to provide spaces for the number of months' service remaining in each engine. The first column at the left shows the name of the division, the next column is for engines in the shop during the current month, and the next column is for engines expected to shop in the succeeding month. Then there are spaces for engines good for one month, two months, three months, etc., up to a column for engines with 12 or more months' serviceability. The last two spaces at the right are for white leaded engines and for those waiting shop.

The Wabash board is 66½ in. wide by 43-⅝ in. high, but the board and the width of the divisional spaces can, of course, be made of whatever dimensions are necessary to accommodate blocks for all engines on the railroad. In the illustration, the blocks have been indicated for one division only, whereas, in using the board, every engine owned is represented by its numbered block. Each engine block is a one-inch cube of yellow pine, with each side painted a different color of the following significance: Blue—Class 1 or 2 repairs; red—Class 3 repairs; green—Class 5 repairs; yellow—proposed to dismantle; black—flue extension granted; white—white lead.

The engine number is stenciled in ⅜-in. white figures on each side, except the white side, where black figures are used. Under the engine number is stenciled letters indicating various pertinent information concerning that particular engine. At present, the following symbols are being used: B—booster; F—feedwater heater; P—power-reverse gear; W—Walschaert valve gear; —heavy frames; S—superheater.

A small No. 16 gage iron "key" shows for ready reference the various engine block markings. These markings are made use of usually in connection with an improvement program for one or several classes of engines, and the scheme permits of showing any desired special information concerning any engine.

The method of manipulating the blocks is simple. Once a month, after the master mechanics have had their condition-of-engines conferences and reported the months' serviceability in each of the locomotives assigned



Detailed arrangement of condition-of-engines board used in the motive-power office of the Wabash

to their divisions, the locomotive record clerk places each engine block in the proper month, whitelead, or waiting shop, vertical space. Then the assistant superintendent of motive power places in the "In Shop" space the blocks for the engines expected to receive classified repairs during the current month, and in the "Next Month" column the engines that will probably receive classified repairs in the succeeding month. When an "In Shop" engine leaves the shop, it is not placed in the 12-month or whitelead space at once, but is placed on the right side of the "In Shop" space and remains until the end of the month. Similarly, when a "Next Month" engine enters shop before the end of the month, the block is placed to the left side of the "Next Month" space until the end of the month.

Swing Gates for Drop-Pit Tables

DROP-PIT table platform tops rarely have a dimension across the drop pits greater than 11 ft. since, if this distance is increased, certain classes of locomotives will have more than tow pairs of driving wheels resting on these tops at one time. With three pairs of such wheels on a drop-pit table top, capacities must be increased, which in turn increase the price of the entire installation. The greatest objection, however, to table tops longer than 11 ft. is the problem confronted in dropping single pairs of rear or front driving wheels under switch engines where rear or front ends must be temporarily supported on areas beyond the drop pit. Furthermore, some roads do not care to have two pairs of driving wheels supported on grease cellars while another pair is being dropped.

The modern locomotive has introduced new problems in that it is frequently necessary to drop complete six-wheel tender trucks and two- or four-wheel trailer

trucks, with or without boosters, at minimum expense. In order that this work may be performed on a table top of the usual length, with the knowledge that this length is sufficient for the wheel bases of these trucks, but insufficient for the overall length of interfering truck parts, the Whiting Corporation originated its self-supporting swing gates, pivoted to the side walls of single or double shoulder pits. Through their addition, it is now possible to drop, on a standard drop-pit table, two pairs of large driving wheels, a complete six-wheel tender truck or a four-wheel trailer truck with booster, even though the last-mentioned truck has an overall dimension of 21 ft.

The view accompanying the article shows a Whiting drop pit equipped with a shoulder pit on each of its side walls. The shoulder pits are approximately 40 in. deep and 5 ft. wide. The swing gates in these shoulder pits are locked in "Out" position. Each of the table top's four locking bars is locked into the end recess of each gate. The drop-pit table, itself, has been racked to another stall.

It will be noted that the table top and four swing gates are supporting the entire six-wheel tender truck and its load. All three pairs of truck wheels are on the table top and the truck frame protrudes beyond the ends of the top. Note that the outside end of the gate in the foreground has a supporting bracket resting on a metal plate, which is flanged at its inside edge in order to keep its rail in alinement. Also note the protective pivoted brace, and the gate lock located near the base of the supporting bracket of the gate.

To release the truck, it is necessary only to bring the jack portion of the drop-pit table under its top and raise the latter slightly for the release of its four locking bars. The gate braces are disconnected and swung into their floor recesses, gates unlocked and swung against the side walls of the shoulder pits. The table top with its load now is lowered sufficiently to clear the tender, racked sidewise and raised to ground level between stalls for release across a shoulder pit on special rails resting on



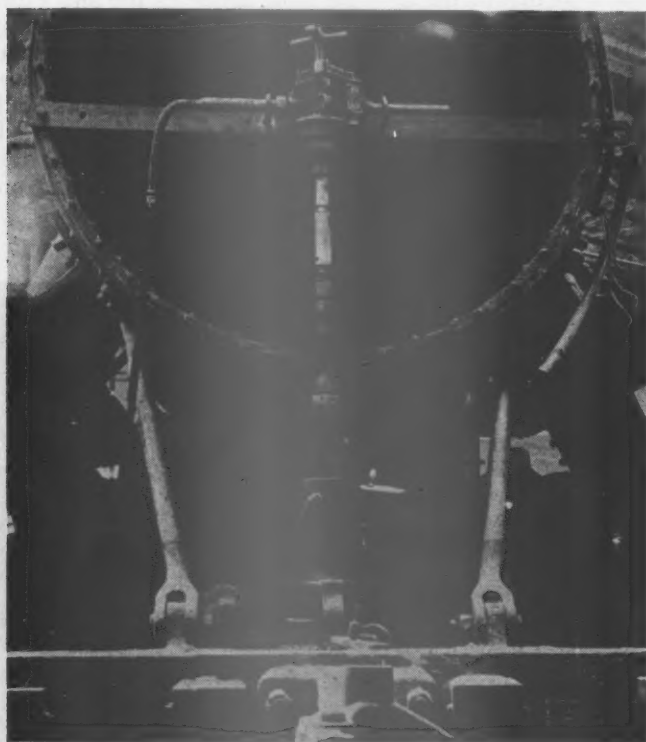
Dropping a six-wheel tender truck on a Whiting drop-pit table equipped with two swing gates

the pit wall and on two of the locking bars. If release is to be made on a stall track, the racking movement to this stall is continued after the table top is raised to ground level.

Shoulder pits and gates need be applied to only one of the several pits served by the drop pit. They may be applied to old installations, and with moderate expense the railroads can modernize their installation, whereby it will be possible to handle two pairs of large driving wheels at one time, or complete six-wheel tender trucks and two- and four-wheel trailer trucks.

Truing Worn King-Pin Holes

THE use of an air motor-driven boring bar, especially adapted for truing worn king-pin holes in locomotive front-deck castings, is shown in the illustration. The device consists of a boring bar, clamped to the deck casting, as shown, and provided with a three-jaw tool holder, with spindle extension to the compound air motor, suitably supported on a crossbar bolted to the smoke-box front end. Hand feed of the spindle and cutting tool is provided by means of the small hand



Boring bar as used to true the worn king-pin hole in a front deck casting

wheel, shown, and the tool bits also are hand adjusted and held by set screws to bore the proper size hole.

One or two cuts are usually necessary, depending upon the wear, and the hole can then be bushed to bring it back to the standard size. In case of subsequent wear, it is only necessary to renew the bushing. The use of a boring bar in this connection is a great time- and labor-saver, since, otherwise, the deck casting would have to

be removed in order to perform the machine operation on a stationary machine tool. Subsequent delay and labor cost in reapplying the casting would also be necessitated.

Applying Air Reservoirs

THE crane attachment illustrated has proved very satisfactory for applying and removing main air reservoirs at the Chicago shops of the Chicago & North Western. It consists of a bolted double-bar structure, forged to a right-angle bend at the upper end to provide



Main reservoir lifting device used at the Chicago shops of the C. & N. W.

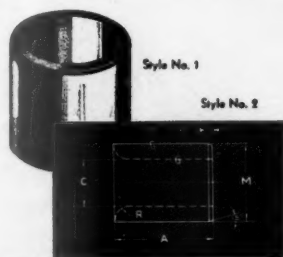
the offset attachment to the supporting chain from the shop crane, and having half-round hooks at the lower end to extend underneath the reservoir and support it in a horizontal position during the lifting operation. The offset construction of this device permits lifting the air reservoir against the blocks underneath the running board, which could not be done with a direct chain or cable attachment from the crane hook to the reservoir. To provide against the possibility of straining the device or bending the running-board brackets, in case the lifting motion of the crane is not stopped quite quickly enough, the lifting I-bolt is spring supported. A safety chain is also provided, as an additional precaution against failure of the lifting device.

Railroad Pins And Bushings

FOR many years, the pins and bushings used in locomotive driver brake and spring rigging, passenger-car and tender-truck brakes, have presented an important problem. Originally, the hangers, equalizers, rods, frames, etc., were equipped with a type of pin and bushing which developed wear rapidly and, therefore, had a relatively short service life. Most of the railroads made these parts in their own shops and, due to the lack of adequate manufacturing facilities, they were unable to handle the necessary machining, heat-treatment and grinding operations with the desired degree of accuracy and low unit cost. Tolerances were not held, holes not reamed accurately, and not enough importance was attached to the quality of the material used. As a result wear was rapid, necessitating frequent repairs or replacement between shoppings, with attendant excessive maintenance cost and interruptions of service.

Recognizing the savings which could be made by the use of pins and bushings of superior certified quality, incorporating the proper hardness, tolerances and performance, representatives of a number of railroads met July 14, 1932, at the Detroit (Mich.) plant of the Ex-Cell-O Aircraft & Tool Corp., to agree upon certain standard-size pins and bushings which could be manufactured in quantities at low unit cost, using the modern

Table 1—Typical Partial Table of Standard Sizes for Ex-Cell-O Hardened and Ground Steel Railroad Bushings



Style No.	Bushing No.	C	M	A	R	Style No.	Bushing No.	C	M	A	R	Style No.	Bushing No.	C	M	A	R
1	2100	1	1½	1		1	2120	1½	1½	2½		1	2195	1½	2½	2½	
1	2129	1½	1½	½		1	2140	1½	1½	1		1	2200	1½	2½	3	
1	2148	1½	1½	¾		1	2152	1½	1½	1½		1	2205	1½	2½	3½	
1	2131	1½	1½	¾		1	2125	1½	1½	1½		1	2210	1½	2½	3½	
1	2107	1½	1½	1		1	2130	1½	1½	1½		1	2215	1½	2½	4	
1	2109	1½	1½	1		2	2013	1½	1½	2½	½	1	2220	1½	2½	3½	1½
1	2132	1½	1½	1½		1	2135	1½	2	1½		1	2225	1½	2½	3½	1½
1	2105	1½	1½	1½		2	2041	1½	1½	3½	½	1	2230	1½	2½	1½	
1	2147	1½	1½	¾		1	2136	1½	2	1½		1	2235	1½	2½	3½	1½
1	2127	1½	1½	¾		1	2116	1½	2½	1½		1	2240	1½	2½	2	
1	2114	1½	1½	¾		1	2101	1½	2½	2		1	2245	1½	2½	2½	
1	2265	2	2½	1½		1	2455	2½	2½	3½		1	2540	3	3½	4	
1	2370	2	2½	1½		1	2460	2½	2½	3½		1	2545	3	3½	4½	
1	2375	2	2½	1½		1	2465	2½	2½	4		2	2550	3½	3½	4½	½
1	2380	2	2½	2		1	2470	2½	2½	4½		1	2555	3½	3½	2½	
1	2285	2	2½	2½		1	2126	2½	2½	2		2	2560	3½	4½	1½	
1	2290	2	2½	3		1	2131	2½	2½	2½		1	2565	3½	4½	2½	
1	2295	2	2½	3½		1	2471	2½	3	1		1	2570	3½	3½	7½	
1	2400	2	2½	3½		1	2475	2½	3	1½		1	2575	3½	4½	4	
1	2405	2	2½	3½		1	2480	2½	3	1½		1	2580	4	4½	5	
1	2183	2½	2½	1½		1	2485	2½	3	2							
1	2128	2½	2½	2		1	2490	2½	3	2½							
1	2104	2½	2½	2½		1	2495	2½	3	3							

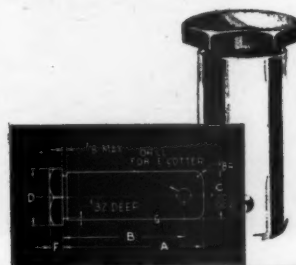
plant and production facilities of this company. Blue prints, furnished by over 30 roads, were studied, and, by the elimination of unnecessary sizes and types, the number of sizes of bushings was reduced from approximately 1,500 to 141 and pin sizes from 1,800 to 173.

The bushings adopted as standard are made from S.A.E. 1010 steel, carburized to a depth of $\frac{1}{32}$ in, and hardened to approximately 60 C Rockwell scale, or 610

Brinell equivalent. They are ground smoothly to .002 in. tolerance to remove scores and tool marks and permit assembly with the pins having the proper tolerances. The hard case provides many times the wear of soft steel parts, and the soft core gives toughness to withstand the shocks incident to heavy-duty service. The hard, smooth, ground surfaces do not permit grit to accumulate, but pulverize it and cast it off.

Fairly close tolerances are provided to prevent seizing and to insure proper clearance between the pin and bushing. For example, there is a standard clearance of $\frac{1}{32}$ in. and the bushing and pin tolerances are .010 in.; if the pin is on or slightly over the high limit and the bushing is on or slightly under the low limit, seizing may result.

**Table 2—Partial Table of Sizes for Ex-Cell-O Hardened
And Ground Railroad Pins**



Pin No.	C	B	A	D	E	F	Pin No.	C	B	A	D	E	F	Pin No.	C	B	A	D	E	F	
1 5000	11	13	5	13	3	3	1 5320	13	13	1	11	13	3	3	1 2628	11	7	7	2	3	3
1 5001	11	23	3	13	3	3	1 5501	13	13	3	3	13	3	3	1 3322	11	3	3	2	3	3
1 5002	3	3	33	13	3	3	1 5519	13	13	5	3	13	3	3	3323	11	—	3	—	—	—
1 5003	11	33	3	13	3	3	1 5505	13	5	3	3	13	3	3	1 3031	11	3	7	2	3	3
1 5004	11	23	43	13	3	3	1 5524	13	53	6	13	3	3	1 5032	11	13	5	2	3	3	
1 5005	11	43	5	13	3	3	1 3503	13	6	6	13	3	3	3033	11	13	11	—	—	—	
1 5006	11	43	5	13	3	3	1 5511	11	23	3	13	3	3	1 5031	11	33	3	2	3	3	
1 5007	11	43	53	13	3	3	1 5015	11	21	3	13	3	3	1 5033	11	3	1	2	3	3	
1 5008	13	23	3	13	3	3	1 5513	11	3	3	13	3	3	1 5036	11	3	43	2	3	3	
1 5062	11	53	53	23	3	3	1 5081	11	103	107	23	3	3	1 5107	23	03	93	3	3	3	
1 5063	11	53	6	23	3	3	1 5086	23	3	73	23	3	3	1 5100	23	03	912	3	3	3	
1 5064	11	57	6	23	3	3	1 5087	23	3	83	23	3	3	1 5109	23	9	103	3	3	3	
1 5065	11	61	63	23	3	3	1 5088	23	43	83	23	3	3	1 5110	23	103	103	3	3	3	
1 5066	11	63	67	23	3	3	1 5099	23	53	23	23	3	3	1 5111	23	103	103	3	3	3	
1 5067	11	65	73	23	3	3	1 5090	23	33	63	23	3	3	1 5112	23	103	113	3	3	3	
1 5068	11	61	73	23	3	3	1 5091	23	6	63	23	3	3	1 5114	31	103	113	43	3	3	
1 5069	13	73	73	23	3	3	1 5092	23	63	67	23	3	3								
1 5070	13	73	83	23	3	3	1 5093	2	63	73	23	3	3								
1 5071	11	73	83	23	3	3	1 5094	2	63	73	23	3	3								
1 5072	11	73	83	23	3	3	1 5095	23	73	73	23	3	3								

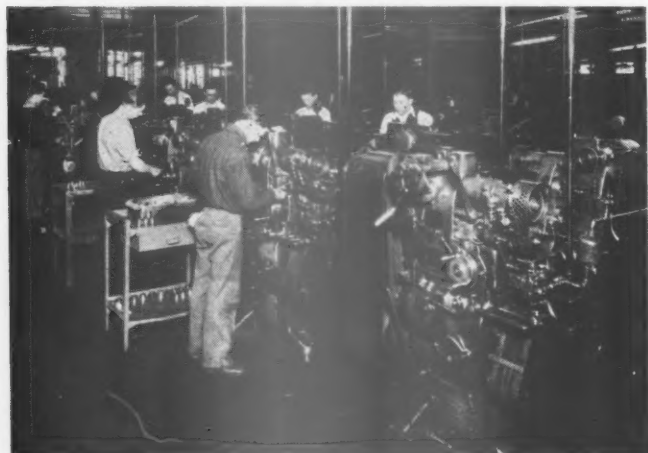
This is doubly true where the rod or hanger holes are reamed slightly out of line, which is frequently the case. With .002-in. tolerance for both the bushing and pin, there is no possibility of seizing, and, contrary to common belief, it does not increase costs, since the hole-grinding machines operate entirely automatically.

Test applications have been made in a number of railroad shops, car and locomotive brake and spring rigging being equipped with the new Ex-Cell-O products. One of the first installations was on the kitchen end of a dining car, which has since run about 250,000 miles with only approximately .002-in. wear. Soft steel pins and bushings, applied at the same time at the opposite end of the car, showed .001-in. wear at the end of 1,300 miles of service and have since been replaced.

Second and third standardization meetings were held in the fall of 1932 to consider the more difficult problem of pin standardization, with a view to eliminating unnecessary types and sizes. It was brought out clearly that the threaded and slotted pin would cost the railroads considerably more than the plain pin with a cotter, or even the plain pin with a hardened precision washer and plain cotter pin. As a result, the railroads were advised

to eliminate the threaded and the slotted pin and base their standard on the plain pin with a washer. The use of a washer was not considered absolutely necessary but, in many cases, it should be used as a precaution to eliminate the shearing of the cotter pin.

Work continued on the pin standard, and, on July 13 and 14, 1933, the railroad representatives again met in Detroit to consider the finished standard. All varying weights of locomotives had been considered, and the



Battery of grinders equipped with Ex-Cell-O internal grinding spindles for finishing medium and small size holes

entire study was laid before those present. Any hesitancy to depart from the old accustomed practices was dissipated when it was shown by actual shear and bend test reports that the product proposed had a three-to-one safety factor over the 55,000-lb. minimum tensile strength requirement, and the railroad men present agreed that the change-over could be safely made. Thus, the standard was developed over a three-year period with the active co-operation of the railroads and after conference with, and the general approval of, interested committees of the American Railway Association, Mechanical Division.

Ex-Cell-O pins and bushings are hardened and ground to tolerances which do not vary. The bushings can be pressed immediately into old hanger holes and stay in service for several hundred thousand miles. When replacement becomes necessary, the old bushings are pressed out and new ones pressed in without building up holes or disturbing the set-up in any way. Tests on one of the railroads are said to have shown that the bushings can be pressed in and out 15 times without destroying the press fit.

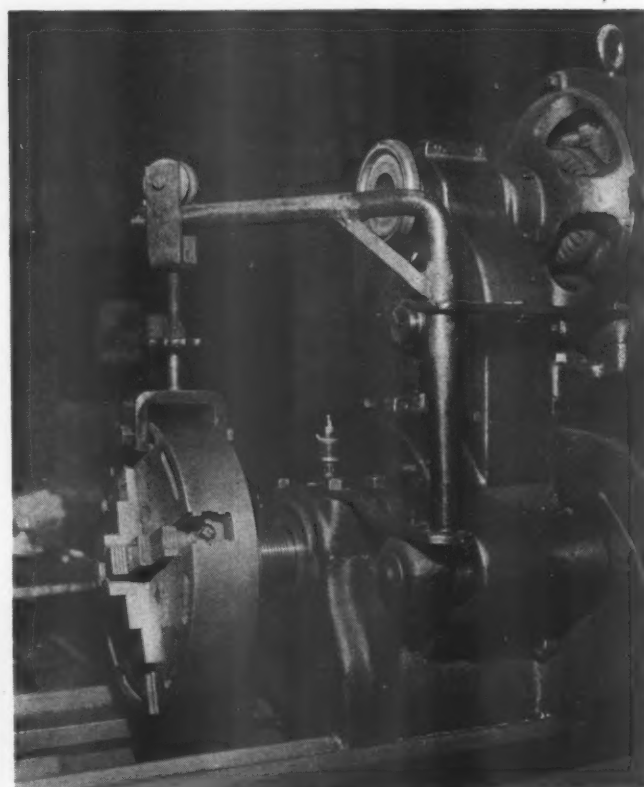
Brake performance is better because wear is not sufficient to destroy the even take-up of the original air brake application. The use of bushings for brake-beam ends has effectually eliminated the necessity of building up beam ends by welding in the back shop. By using certified standard bushings and pins, it is no longer necessary to replace hangers, brake heads, rods, etc., as the wear is slight.

Approximately 40 railroads and 12 firms manufacturing products strictly for railroad consumption are said to be now using the Ex-Cell-O products. The standard sizes adopted do not include every pin or bushing used on each individual railroad, which would require many types, involving small lots not conveniently carried in stock. It does, however, cover approximately 90 per cent of all the pin and bushing sizes used by the railroads, which is substantially all that any standard can include. On receipt of a set of detail drawings for locomotives or

cars, the Ex-Cell-O Aircraft & Tool Corporation will make a complete check and recommendation of standard sizes which have been found by experience to give satisfactory performance.

Lathe Chuck Carrier

A SIMPLE but effective means for handling chucks which must be frequently applied to and removed from lathe spindles is shown in the illustration. The device consists of a 1 1/8-in. round-steel bar bent at right angles and suitably supported on the engine-lathe head in such a way that the horizontal part of the bar which carries a roller and hand-screw support for the chuck can be swiveled so that the chuck may be either swung



Chuck-handling attachment applied to an engine lathe

into line with the engine-lathe spindle or readily pushed around back of the engine-lathe head where it is out of the way. It will be noted that a small, diagonal arm is welded across the corner of the round supporting bar to give it additional stiffness. A stop pin is inserted in the outer end of the horizontal bar to prevent any possibility of the roller support leaving the bar and dropping the chuck. Hand-screw adjustment for height is provided, as shown; also convenient means for quickly attaching the clamp to the top of the chuck.

THE INDIANAPOLIS UNION RAILWAY COMPANY has been awarded the achievement cup by the Smoke Abatement League of Indianapolis, Ind., for making the best record of any railroad in the city in the past year. The line's record was 0.86 per cent violation or 8.6 violations recorded in every 1,000 observations. The Pennsylvania was second with 8.8 violations and the Cleveland, Cincinnati, Chicago & St. Louis, was third.

NEWS

THE NORTHERN PACIFIC has undertaken the construction of extensions to five stalls of its Mississippi Street enginehouse at St. Paul, Minn.

I. C. C. Moving to New Offices

THE BUREAU of Locomotive Inspection, the Bureau of Safety, and the Bureau of Service of the Interstate Commerce Commission have moved their offices to the new Interstate Commerce Commission building at Twelfth street and Constitution avenue, Washington. The general offices of the commission are expected to move shortly.

for April, showing a total of 1,017,008 employees and a total compensation of \$123,427,450, and a statement showing the index of railway employment since January, 1932, using preliminary figures for May and June.

Equipment on Order

CLASS I RAILROADS on July 1 had 17,813 new freight cars on order, according to reports received by the Car Service Division of the American Railway Association. On the same day last year, 1,205 new freight cars were on order and on the same date two years ago, there were 1,951.

New Equipment

		CAR ORDERS			
Road	No. of cars	Type of car	Builder		
Norfolk Southern	2 ¹	Gas-rail motor	A. C. & F.		
Uruguayan State Rys.	4	Rail motor	J. G. Brill Co.		
		CAR INQUIRIES			
Ill. Central	1 ²	Rail motor	.....	
	1 ²	Bagg.-mail-exp.	.....	
	1 ²	Smoker and coach	.....	
	1 ²	Coach	.....	
	1 ³	Cafe-lounge	.....	
	1 ²	Parlor-observ.	.....	
		LOCOMOTIVE ORDERS			
Road	No. of locos.	Type of locomotive	Builder		
Pennsylvania	12 ³	Elec. pass.	West. Elec. & Mfg. Co.		
	5 ³	Elec. pass.	Gen. Elec. Co.		
	11 ³	Elec. pass.	Company shops		

¹ An option has been taken on two additional cars.

² These six cars are for the streamlined train mentioned in the July issue.

³ These 28 of the 101 electric locomotives to be financed by the P.W.A., as noted in the February issue, will cost over \$6,000,000.

Railway Employment Steadily Increasing

THE NUMBER of employees of Class I railroads as of the middle of the month of June was 1,054,089, according to the Interstate Commerce Commission's preliminary monthly tabulation of railroad employment statistics. This was an increase of 10.08 per cent as compared with the number in June, 1933, and of 1.06 per cent as compared with May, 1934. The maintenance of way and structures group showed an increase of 15.6 per cent as compared with June, 1933, and the maintenance of equipment group showed an increase of 15 per cent, but the train and engine service group showed an increase of only 8.72 per cent. The commission has also issued its more complete statement

The railroads on July 1 also had 40 new steam locomotives on order and 107 electric locomotives. New steam locomotives on order on July 1, 1933, totaled one and on July 1, 1932, there were six on order.

In the first six months of 1934, the railroads installed 5,360 new freight cars. In the same period last year, 1,251 new cars were placed in service and for the same period two years ago, the total number installed was 1,927. One new steam locomotive and eight new electric locomotives were installed in service in the first six months this year. The railroads in the first six months of 1933 installed one new steam locomotive, and 34 in the corresponding period in 1932.

Freight cars or locomotives leased or otherwise acquired are not included in the above figures.

Eastern Car Foreman's Outing

THE RACE BROOK Country Club, New Haven, Conn., was the scene of the second annual outing of the Eastern Car Foreman's Association on July 19, at which approximately 215 members and guests were in attendance. Numerous events were on the program of entertainment and the outing was climaxed by a dinner at the club house, after which the prizes for the many events were awarded.

The golf tournament, in which 107 persons took part, was probably the most important event of the day. The winners in Class A were R. P. Townsend and C. E. Bryant, both of New York, who took the low gross prize with a score of 78. The low net in Class A was won by L. H. Foster. Low gross in Class B was won by H. B. Whitten and low net by H. B. Chamberlain of the Tuco Products Corporation. W. Spieth, American Steel Foundries, was the winner of the low gross prize in Class C and the low net in the same class was won by P. E. Pfeiffer. The driving contest was won by D. J. Molloy of the Crane Company, with a drive of 256 yards. The hole-in-one contest of 40 yards was won by J. J. Wilson of the Apex Tool Company, and F. N. Gregory of the Magnus Company. G. W. Ditmore, Delaware & Hudson, repeated his performance of last year and won first prize in the quoits contest, and H. G. Young, also of the D. & H., took second place. The bridge tournament was won by R. L. Pearson, vice-president and general manager, New York, New Haven & Hartford, and A. E. Ostrander, vice-president, American Car & Foundry Company. In the putting contest for golfers Harry Coston took first prize. Second place resulted in a tie between George Alling and D. B. Carse of the Oxweld Railroad Service Company. The non-golfers putting tournament was won by J. C. Hassett, mechanical engineer, New York, New Haven & Hartford, and W. M. Wadsworth, in which contest there was also a tie for second place between F. H. Reynolds and C. I. Billings.

A. S. T. M. President Dies

WILLIAM HASTINGS BASSETT, president of the American Society for Testing Materials and metallurgical manager of the American Brass Company, died suddenly on July 21 at his home in Cheshire, Conn. Mr. Bassett, who was 66 years old, had been president of the A.S.T.M. only a few weeks, having been elected in June at the annual convention in Atlantic City.



Eastern Car Foreman's Outing at Race Brook Country Club, New Haven, Conn.

Administration Members of Code Authorities

THE NATIONAL RECOVERY ADMINISTRATION on July 9 announced the appointment of the following administration members, without vote, of the code authorities of the several industries indicated below:

Professor R. H. Danforth for the Small Locomotive Manufacturing Industry. Prof. Danforth has been professor of mechanics and materials at the Case School of Applied Science, Cleveland, Ohio, since 1914. He has also served as consultant for the Packard Motor Company, Cleveland Trac-

with arch-bar trucks will be barred from general interchange by an order of the American Railway Association. It is important, he says, that the date for completing this work shall not be extended. On July 1, 1933, there were 658,306 cars, or 32.1 per cent of the total, still equipped with arch-bar trucks. Attached to the letter was a memorandum from O. C. Castle, director of the Section of Car Pooling, giving statistics to show that "there is need for a program directed at the reduction of accidents due to defective or obsolete equipment," and which he believed indicated that "arch-bar trucks are a pro-

the press issued by the P. W. A. Up to June 15, 8,300 men had been put to work in car building shops and 3,700 had been put to work in locomotive building shops by P. W. A. loans of \$61,973,000 to 18 railroads for purchasing equipment, according to reports to the Bureau of Labor Statistics of the Department of Labor by the car and locomotive manufacturers who received the orders for this new equipment.

The \$61,973,000 of loans were made by P.W.A. for purchase of 14,475 freight cars, 264 passenger train cars, 68 steam locomotives and 20 separate tenders for steam locomotives, 76 electric locomotives, 21 Diesel-electric locomotives and 4 articulated stream-lined trains. P.W.A. also has made loans totalling \$23,226,000 for manufacturing 7,920 freight cars, 75 passenger cars and 25 electric locomotives in shops owned by the railroad companies. These loans have created a great amount of employment for railroad shopmen. Additional employment for railroad shopmen has been created by \$28,697,343 of loans to railroad companies for repairing or rebuilding old cars and engines in their own shops. Employment for thousands of trackmen and other outside railroad employees also has been created by P.W.A. loans totalling \$77,132,657 for miscellaneous roadway improvements and the purchase of new rails.

Twenty-two companies have received orders for the equipment being built in outside shops and the 12,000 men employed reported by them to the Bureau of Labor Statistics are at work in their assembly plants located in 23 cities. Only 100 freight cars, 59 electric locomotives, 13 Diesel-electric engines and 1 high speed train remain unordered.

According to the P.W.A. statement, "the car builders reported that out of 12,400 men employed in their assembly plants 8,300, or 66.8 per cent were at work on cars being built with P.W.A. money. The locomotive builders reported that out of 4,127 men at work in their shops 3,700, or 89.6 per cent were employed as a result of P.W.A. loans.

"The men not employed on equipment being manufactured with P.W.A. money were at work on cars and engines ordered by industrial companies or by railroad companies which have not borrowed from P.W.A. The law authorizes P.W.A. to make equipment loans only to railroad companies, and no loans for that purpose have been made to oil or chemical companies, coal or lumber companies, meat packers, milk distributors, steel manufacturers or other industries which own large numbers of cars and engines."

The most recent contract signed by the Public Works Administrator was for a loan of \$255,000 to the Gulf, Mobile & Northern for rail and track work. This is the third loan to the G.M.&N., the first being for \$210,000 to put the company's shopmen to work on the job of building 100 new freight cars in its shops at Mobile, Ala., and Bogalusa, La., and the second being for \$232,000 for the purchase of 150 new box cars being built by the American Car & Foundry Company in its St. Louis plant. A fourth contract covering a loan of \$519,000 for the purchase of new cars and engines is in course of preparation.

(Turn to next left-hand page)

Progress in Air-Conditioning Programs

Road	No. of cars	Type of car	Type of System	Builder
B. & O.	15 ¹	Coaches	Freon	York Ice Machy. Corp.
	16 ¹	Pullman		
Lehigh Valley	2 ²	Club		
	3	Club-dining		
	5	Dining	Mech.	York Ice Machy. Corp.

N. Y., N. H. & H.
(See note 3)

¹ B. & O. passenger cars air-conditioned by the York Company total more than 300. The equipment for the 31 cars noted here is to be installed at the Mount Clare shops of the railroad company at Baltimore, Md.

² All the Pullman equipment on the Black Diamond of this road operating between New York and Chicago is now completely air-conditioned. This includes lounge cars and sleeping cars in addition to the diners.

³ The New Haven now has 152 air-conditioned cars in service on its trains, including 63 coaches, smokers and combination cars, 43 parlor cars, 29 dining cars, 14 sleepers, and 3 club cars. Additional cars are daily being received from the shops where they are being equipped with the air-cooling and purifying systems, and 65 additional cars were expected to be placed in service during the latter part of July. Some of the cars are equipped with an ice-cooling system, and others with mechanical air-conditioning. Next year the management hopes to have all its through train service 100 per cent air-conditioned. By that time the 50 new cars and the stream-lined Rail-Zepelin being built by the Goodyear-Zeppelin Company, all of which will also be air-conditioned, will be ready for service, making possible complete air-conditioning of the entire through service.

tor Company, the Goodyear Rubber Company and the New York Central Railroad.

George C. Dent for the Woodwork Division of the Lumber Code Authority, Inc., for the Lumber and Timber Products Industries. Mr. Dent has been in trade association work. In 1912 he organized the Western Efficiency Society in Chicago and served as its secretary until 1917. He then became secretary of the Society of Industrial Managers.

Edgar E. Brosius for the Code Authority for the Railway and Industrial Spring Industry, a sub-division of the Machinery and Allied Products Industry. Mr. Brosius is president and general manager of Edgar E. Brosius, Inc., Sharpsburg, Penna., manufacturer of blast furnace equipment.

Expedition in Replacement of Arch-Bar Trucks Urged

CO-ORDINATOR EASTMAN has sent to the Regional Co-ordinating Committees of the carriers a letter expressing the hope that the railroads will take such action as may be necessary to expedite the replacement of arch-bar trucks with cast-steel side-frame trucks, and to assure that in no case will any existing arch-bar trucks be replaced in kind, whether in maintenance or betterment work; in other words, that replacements be made exclusively with cast steel side-frames. He had discussed this matter with the committees at his meeting with them a year ago, with the understanding that such replacements were to be carried out as rapidly as possible, and that the work was to be completed by January 1, 1936, after which date cars equipped

with arch-bar trucks will be barred from general interchange by an order of the American Railway Association. It is important, he says, that the date for completing this work shall not be extended. On July 1, 1933, there were 658,306 cars, or 32.1 per cent of the total, still equipped with arch-bar trucks. Attached to the letter was a memorandum from O. C. Castle, director of the Section of Car Pooling, giving statistics to show that "there is need for a program directed at the reduction of accidents due to defective or obsolete equipment," and which he believed indicated that "arch-bar trucks are a pro-

P. W. A. Loans

THE WIDESPREAD effect of the orders for new equipment placed by the railroads with loans from the Public Works Administration is illustrated in a statement for

* * *



G. W. R. train numbers

Numbering of Passenger Trains on the Great Western of Great Britain in heavy Saturday Travel. The "5" indicates that the train originated at Exeter, and "583" means that this is a fourth section of No. 580.



IN AGATHON ALLOY ENGINE BOLTS

Every turn of the wheels brings unbalanced forces into play that tend to rack the locomotive and stretch engine bolts. « « « If the engine bolt gives ever so little, slack develops and a start has been made towards the back shop. « « «

For this exacting service Republic has developed an Agathon Engine Bolt Steel with higher strength and greater shock resistance.

Once in place these bolts hold tight. You can rely on them to cut down frame bolt replacements and thereby reduce maintenance.

CENTRAL ALLOY DIVISION, MASSILLON, OHIO

REPUBLIC STEEL
C O R P O R A T I O N
GENERAL OFFICES YOUNGSTOWN, OHIO

Toncan Iron Boiler Tubes, Pipe, Plates, Culverts, Rivets, Tender Plates and Firebox Sheets • Sheets and Strip for special railroad purposes • Agathon Alloy Steels for Locomotive Parts • Agathon Engine Bolt Steel • Agathon Iron for pins and bushings • Agathon Staybolt Iron • Climax Steel Staybolts • Upson Bolts and Nuts • Track Material, Maney Guard Rail Assemblies • Enduro Stainless Steel for dining car equipment, for refrigeration cars and for firebox sheets • Agathon Nickel Forging Steel... The Birdsboro Steel Foundry & Machine Company of Birdsboro, Pa. has manufactured and is prepared to supply under license, Toncan Copper Molybdenum iron castings for locomotives.



Supply Trade Notes

J. E. O'BRIEN, 135 So. LaSalle street, Chicago, has been appointed administration member on the code authority of the tank car service code.

WILLIAM B. GIVEN, JR., president of the American Brake Shoe & Foundry Company, has been elected a director of the American Arch Company.

A. C. DEVERELL, representative of the Standard Car Truck Company, has resigned to become representative of the Equipment Specialties Company, Chicago.

THE STANDARD STEEL CAR CORPORATION has purchased the Canton Car Company, Canton, Ohio and will continue to operate the plant with its present organization, headed by G. J. Whalen, general manager.

JOHN F. DEEMS has been appointed representative of the Union Asbestos & Rubber Company, Cicero, Ill., with headquarters at 420 Lexington Ave., New York. George L. Green has been appointed representative at Chicago.

THOMAS L. MOUNT, of the Thomas L. Mount Company, 136 Liberty street, New York, has been appointed representative in Eastern territory for the Dayton-Roderwald V-belt drive, used for air conditioning and lighting of passenger cars and for endless V-belts, both of which are manufactured by the Dayton Rubber Manufacturing Company, Dayton, Ohio.

STANLEY A. KNISELY, who has been appointed sales promotion and advertising manager of the Republic Steel Corporation, will have his headquarters at Youngstown,



Stanley A. Knisely

Ohio. Mr. Knisely entered newspaper work in his home city at Canton, Ohio, and later held the positions of city editor and telegraph editor of the Cleveland Plain Dealer. He left that field to become advertising and sales manager of the National Paving Brick Association, with headquarters at Cleveland, Ohio. After six and a half years in that position Mr. Knisely became director of advertising research for the National Association of Flat Rolled Steel Manufacturers and served seven years in that capacity.

MALCOLM E. GREGG, assistant district sales manager of the Inland Steel Company, with headquarters at Milwaukee, Wis., has been appointed district sales manager to succeed Harry L. McCauley, deceased.

CHARLES D. JENKS, president of the Chicago Car Roofing Company, has been elected chairman of the Code Authority of the Railway Car Industry. William H. Winslow, Jr., of Defrees, Buckingham, Jones & Hoffman, was elected secretary.

Obituary

JOHN E. BARKLE, general manager of the South Philadelphia Works of the Westinghouse Electric & Manufacturing Company, died suddenly at his home in Swarthmore, Pa., on July 10 at the age of 53. Mr. Barkle was born at Orbisonia, Pa., and was a graduate of Dickinson College. He had been in the service of Westinghouse continuously for 33 years.

Personal Mention

H. C. TREXLER, master mechanic of the Southern at Spencer, N. C., has been appointed superintendent motive power, eastern lines, with headquarters at Charlotte, N. C.

L. C. SHULTS, superintendent of motive power of the Southern, lines east, Charlotte, N. C., has been transferred to Knoxville, Tenn., as superintendent of motive power, central lines.

M. D. STEWART, superintendent of motive power of the Southern, lines west, has been transferred to Cincinnati, Ohio, as superintendent of motive power, western lines.

J. J. PRENDERGAST, acting mechanical superintendent of the Texas & Pacific, with headquarters at Dallas, Tex., has been appointed mechanical superintendent.

W. S. H. HAMILTON has been appointed equipment electrical engineer, New York Central Lines, with jurisdiction over all engineering matters on electric motive power and rolling stock, and the electrical equipment on steam motive power and rolling stock. Mr. Hamilton was born in December, 1890, at New Haven, Conn. He received his higher education at Sheffield Scientific School, Yale University. In 1911, he became connected with the General Electric Company at Schenectady, N. Y., and held a position in the testing department of that company until 1913, when he became designing engineer. From 1916 to 1917 he was field engineer and during that period he also served as instructor to enginemen, etc., when the first electrification on the Chicago, Milwaukee & St. Paul (now Chicago, Milwaukee, St. Paul & Pacific) was opened. In 1917 he became designing engineer and in 1918 he enrolled for service in the U. S. Navy. During the period he was in that service he was commissioned as ensign and part of the time he was engineering officer of the U. S. S. Henderson. He returned to

H. LEON FULLER, district manager of the Westinghouse Air Brake Company, with headquarters at Denver, Colo., died suddenly in that city on July 8.

L. W. HOSTETTLER, manager of alloy sales, Allegheny Steel Company, Brackenridge, Pa., died on July 10 from injuries received in an automobile accident near Waukegan, Ill.

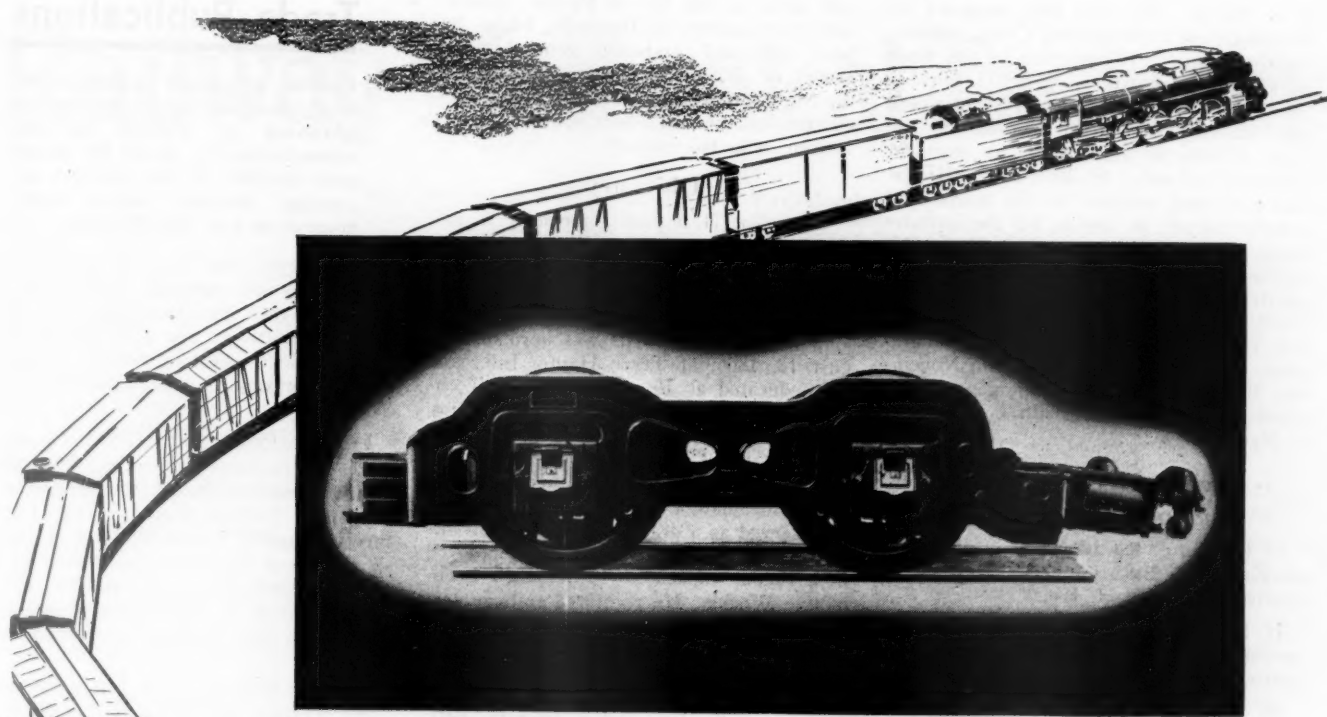
LAWRENCE H. VILAS, president of the Pyle-National Company, Chicago, died suddenly of a heart attack on July 22, in the Palmer House in Chicago. Mr. Vilas was born in 1895 at New York and entered the service of the Pyle-National Company in 1915. After two years, he left this company to serve overseas with the United States army during the World War. Following the war, he returned to the service of the Pyle-National Company in 1919, serving successfully as chief clerk, assistant general manager and general manager until 1928. During the next four years, Mr. Vilas was out of the service of the company, but in 1932 he resumed active service as president, which position he held continuously until his death.

the General Electric Company in 1919 as field engineer, and from 1922 to 1924 as designing engineer, locomotive department; from 1925 to 1927 commercial engineer, railway engineering department; and from 1928 to January, 1931 electrification specialist of the General Electric Company at New York. On the latter date he was appointed assistant electrical engineer, New York Central, which position he held until the time of his present appointment.

D. B. THOMPSON has been appointed mechanical and electrical engineer of the New York Central Lines, with jurisdiction over all electrical matters other than those supervised by W. S. H. Hamilton. Mr. Thompson was born in Lansingburgh, N. Y., on December 14, 1886. He was graduated from Rensselaer Polytechnic Institute with the degrees of C.E. and E.E. He entered the service of the New York Central in 1912 as inspector on mechanical and electrical installations, and was later placed in charge of electric and water service contracts. He was then appointed mechanical engineer in charge of design and specifications for mechanical and electrical installations, at New York, the position he held at the time of his recent appointment.

A. L. RALSTON, assistant general mechanical superintendent of the New York, New Haven & Hartford has been appointed general mechanical superintendent, with headquarters at New Haven, Conn. Mr. Ralston was born in Brazil, Ind., and was graduated from Purdue University in 1905. He then took a special apprenticeship course with Westinghouse Electric & Manufacturing Company at Pittsburgh, Pa., specializing in railroad work. During 1906 and a part of 1907 he worked in the engineering department of the Westinghouse Company on the development of design and construction of the first electric locomotives built for the

(Turn to next left-hand page)



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New Haven. He was then assigned by Westinghouse to Stamford, Conn., remaining there until 1914, assisting in the work of electrification of the New Haven between New York and New Haven, Conn. Mr. Ralston entered the service of the New Haven in May, 1914, as assistant electrical engineer. In February, 1915, he was appointed assistant to the mechanical superintendent, in charge of the maintenance of electrical equipment; in May, 1917, engineer of electric traction, with headquarters at Grand Central terminal, New York, and in September, 1918, mechanical superintendent in charge of maintenance of electric equipment and in November, 1932, he became assistant general mechanical superintendent with headquarters at New Haven.

Master Mechanics and Road Foreman

G. F. TIPTON has been appointed master mechanic of the Southern, with headquarters at Somerset, Ky.

H. B. NABORS has been appointed master mechanic of the Southern, with headquarters at Princeton, Ind.

M. R. BROCKMAN has been appointed master mechanic of the Southern, with headquarters at Spencer, N. C.

G. L. BUUCK has been appointed trainmaster and road foreman of engines on the Toledo division of the Pennsylvania, with headquarters at Toledo, Ohio.

Purchasing and Stores

J. L. IRISH, assistant general storekeeper of the Oregon Short Line, the Oregon-Washington Railroad & Navigation Company and the Los Angeles & Salt Lake

(all units of the Union Pacific System), with headquarters at Pocatello, Idaho, has been appointed assistant general storekeeper of the Union Pacific Railroad and the St. Joseph & Grand Island, with headquarters at Omaha, Neb., succeeding O. Nelson, who has retired.

Obituary

THEODORE H. CURTIS, formerly a mechanical officer on a number of railroads and more recently a consulting engineer on railroad mechanical matters at Chicago, died on July 15 in that city following a long illness. Mr. Curtis was born on August 12, 1866, at Terre Haute, Ind., and was educated at Rose Institute of Technology in that city. He entered railway service in 1886 as chief mechanical draftsman for the Cincinnati, Indianapolis, St. Louis & Chicago (now part of the Cleveland, Cincinnati, Chicago & St. Louis). He then served as a draftsman for the Brooks Locomotive Works and later was employed in a similar capacity by Pittsburgh Locomotive Works. He reentered railway service in June, 1889, as chief draftsman for the New York, Chicago & St. Louis, being appointed mechanical engineer in 1897. Two years later he became mechanical engineer of the Erie and in January, 1901, he entered the service of the Louisville & Nashville as mechanical engineer. In August, 1903, Mr. Curtis was appointed superintendent of machinery of the L. & N. leaving this company in July, 1911, to become mechanical engineer for the Committee on Investigation of Smoke Abatement and Electrification of Railway Terminals of the Chicago Association of Commerce. Since February, 1915, he had been a consulting railroad engineer in private practice at Chicago.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

LOCOMOTIVE AND CAR SCRAPPING.—Detailed data on methods and results of scrapping cars and locomotives on three different railroads are given in an illustrated booklet issued by the Air Reduction Sales Company, Lincoln building, New York.

LUKENS CROMANSIL STEEL.—Cromansil steel—its physical properties, fabrication, riveting, application, etc.—is described in an 8-page bulletin issued by the Lukens Steel Company, Coatesville, Pa. Cromansil steel was developed to replace carbon steels in applications where a steel having a combination of high strength and good ductility in the "as rolled" condition is required.

TESTING WELDERS AND THEIR WELDS.—"The Testing and Qualification of Welders" is the title of a 24-page, illustrated booklet issued by the Linde Air Products Company, 30 East Forty-Second street, New York. The booklet outlines simple tests for measuring the ability of welders and discusses fracture, bend, tensile and observation tests. An eight-page pamphlet entitled "The Progress of Bronze-Welding" contains an instructive story of bronze-welding in all its phases. Another five-page pamphlet describes "The Principles of Bronze-Welding."

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70-ton two-compartment covered hopper car built by the American Car & Foundry Company for bulk shipments of cement

A.R.A. Class	LO	Truck wheel base	5 ft. 8 in.
Length inside	29 ft. 3 in.	Capacity, cubic	2,050 cu. ft.
Length over strikers	35 ft. 1 1/4 in.	Capacity, barrels (378 lb. per bbl.)	415 barrels
Width inside	9 ft. 5 1/2 in.	Axle journals	6 in. by 11 in.
Height—rail to top running board	12 ft. 10 3/4 in.	Slope sheet angles	50 deg.
Height—rail to eaves	11 ft. 10 in.	Light weight	53,100 lb.
Center to center trucks	25 ft. 3 in.	Load limit	156,900 lb.